

*The
Kentucky Geological
Survey*

WILLARD ROUSE JILLSON
DIRECTOR and STATE GEOLOGIST



SERIES VI
VOLUME SEVENTEEN

*Geology and Mineral
Resources of Kentucky*

1928



Western Kentucky Fluorite—Ca F₂
½ Natural Size

The GEOLOGY and **MINERAL RESOURCES** *of KENTUCKY*

A Brief Description of the Physiography, Stratigraphy, Areal and
 Structural Geology, and Mineral Resources of Each of
 the Counties Comprising the Commonwealth



BY

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*Illustrated with Two Hundred and Fifty-one Photographs,
 Maps and Diagrams*

THE KENTUCKY GEOLOGICAL SURVEY
 FRANKFORT, KY.

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Dedicated to the Memory of
THOMAS CHROWDER CHAMBERLIN
Eminent Geologist
Teacher and Friend

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Preface

Among the many thousands who are actively interested in Kentucky Geology there is hardly a person who does not confess a desire to know something concerning the rocks at points somewhat removed from his actual residence. It is natural that such interests should assert themselves, for geology either as a field of professional investigation or as an item of scientific culture is itself broadening. It invites wonder and thoughtful speculation, which attitudes when coupled with normal intellectual experiences tend to produce a philosophical trend of mind.

In presenting the several items enclosed within these covers, it has been the writer's intention to supply the foundation material necessary to a broad yet none the less sound conception of the geology of every part of Kentucky. This volume is therefore not primarily a text book from which the science may be learned but a source book from which an outline of the geology of any particular part of this State may be quickly gleaned. While written purposefully for the use of the general public rather than geologists, a certain amount of geological terminology has been employed in order to avoid many repetitions and tedious explanations.

All of the literature pertaining to the geology of Kentucky has been freely drawn upon in the course of the preparation of this manuscript which in the main presents the observations and reflections of the writer gained during the past twelve years of active professional field and office work in this State. The photographs presented, with a few notable exceptions, were all secured by the author during the progress of official investigations in all parts of Kentucky for the Kentucky Geological Survey.

M. R. Gillman

Director and State Geologist

Old State Capitol,
Frankfort, Ky.
Feb. 1, 1928.

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Geology and Mineral Resources of Kentucky

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I.

ADAIR COUNTY

Adair, a Pennyroyal county, containing about 400 square miles, is situated in central-southern Kentucky, its eastern boundary being more or less coincident with the axis of the Cincinnati Arch. It is drained by Green River and its principal local



RIDGE AND BOTTOM LANDS IN SOUTHERN ADAIR.
The hills are frequently steep of slope and timbered, but usually not high. Good farming follows the streams.

tributary, Russell Creek. The normal dip of the rocks is slightly to the north of west. The county is rolling to hilly with occasional isolated knobs. Columbia, the county seat, has an elevation of about 750 feet above sea level.

The hard rocks exposed at the surface consist principally of Middle and Lower Mississippian limestones, shaly limestones, and shales with small inliers of the underlying Chattanooga (Devonian) black shale exposed on Casey Creek in the vicinity of Knifley and on the main waters of Green River in the vicinity

of Pellyton and Neetsville. A very restricted inlier of Upper Ordovician limestone and shales occurs, possibly due to local anticlinal structure, on Damaron Creek in this same vicinity. Small outliers of disintegrated Pottsville (Pennsylvanian) quartz gravels occur on the Taylor and Casey County line ridges in the northern part of Adair, while Recent alluviums are present in the bottoms of all of the larger streams.

The principal mineral resource of Adair County is limestone, which is found in good quality, broadly distributed. Residual and transported clays suitable for brick manufacture are also present. A number of wells have been drilled for oil and gas into the "Corniferous" (Devonian) limestone with some success. Upper Ordovician "sands" such as the "Sunnybrook" are practically untested in this part of Kentucky and afford good prospecting possibilities. The Devonian black shale offers a reserve from which artificial petroleum may sometime be produced. Transported gravels occurring as creek deposits are available for highway and concrete construction.

A reconnaissance geological map of Adair County, of date 1924, scale 1:62,500, is available. Topographically the county is unsurveyed.

II.

ALLEN COUNTY

Allen County is located in southern Kentucky adjoining the Tennessee line. Its area covering about 394 square miles is drained by the Barren River and two of its tributaries, South Fork of Drakes Creek and Trammel Creek. A typical Pennyroyal district, it is undulating to hilly in physical aspect. Scottsville, the county seat, is 761 feet above sea level. The lowest elevation, 460 feet, is found at Martinsville Ford at the juncture



DEVONIAN LIMESTONE ALONG BARREN RIVER.
In eastern Allen County and western Barren County calcareous beds correlated with the Onondaga come to outcrop. Elsewhere in this part of Kentucky the "Corniferous" contains petroleum.

of Bays Fork and Barren River. Upland ridges range from 750 to about 850 feet above sea level, giving a normal local relief of about 150 to 175 feet.

Structurally this county is slightly to the west of the crest of the Cincinnati Arch. The normal dip of the rocks is therefore north 45 degrees west. The rocks exposed at the surface consist of the Middle and Lower Members of the Mississippian System, these being the St. Louis, the Fort Payne limestones, and the New Providence shale. The St. Louis limestone is broadly distributed throughout the northwestern part of the county where it produces numerous "sink holes" for under-

ground streams. The Lower Mississippian formations extend southeastward along the streams up to and including the divides at the county line. On the waters of Trammel Creek and on the upper waters of Barren River above the mouth of Peters Creek the basal Mississippian is cut through, exposing the Chattanooga (Devonian) black shale underlying, and Corniferous (Devonian) limestone and uppermost Niagaran (Silurian) limestone. Local folds of an anticlinal nature are of frequent occurrence but faulting of a pronounced degree is not known to occur in this part of the State.

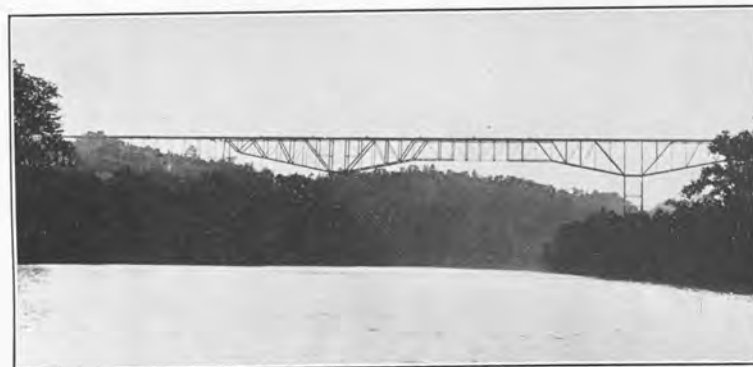
The principal mineral resources of Allen County are petroleum, natural gas, and limestone. During the seven-year period, 1919-1925, 3,654,749 barrels of oil were produced from about ten important pools. This county has also produced considerable quantities of natural gas. Limestone suitable for rough building construction and as road and railroad materials; creek and river gravels, particularly from the Barren River, are present in large and inexhaustible quantities. Residual clays on the uplands and transported clays along the streams are available for brick manufacture.

An areal and structural geological oil and gas map of Allen County, published in 1919, scale 1 inch equals 1 mile, is available. The topography of this district has recently been completed and may be seen on the Bowling Green, Scottsville, Bucklodge, Adolphus and Red Boiling Springs quadrangles, scale 1:62,500, 20-foot contour interval.

III.

ANDERSON COUNTY

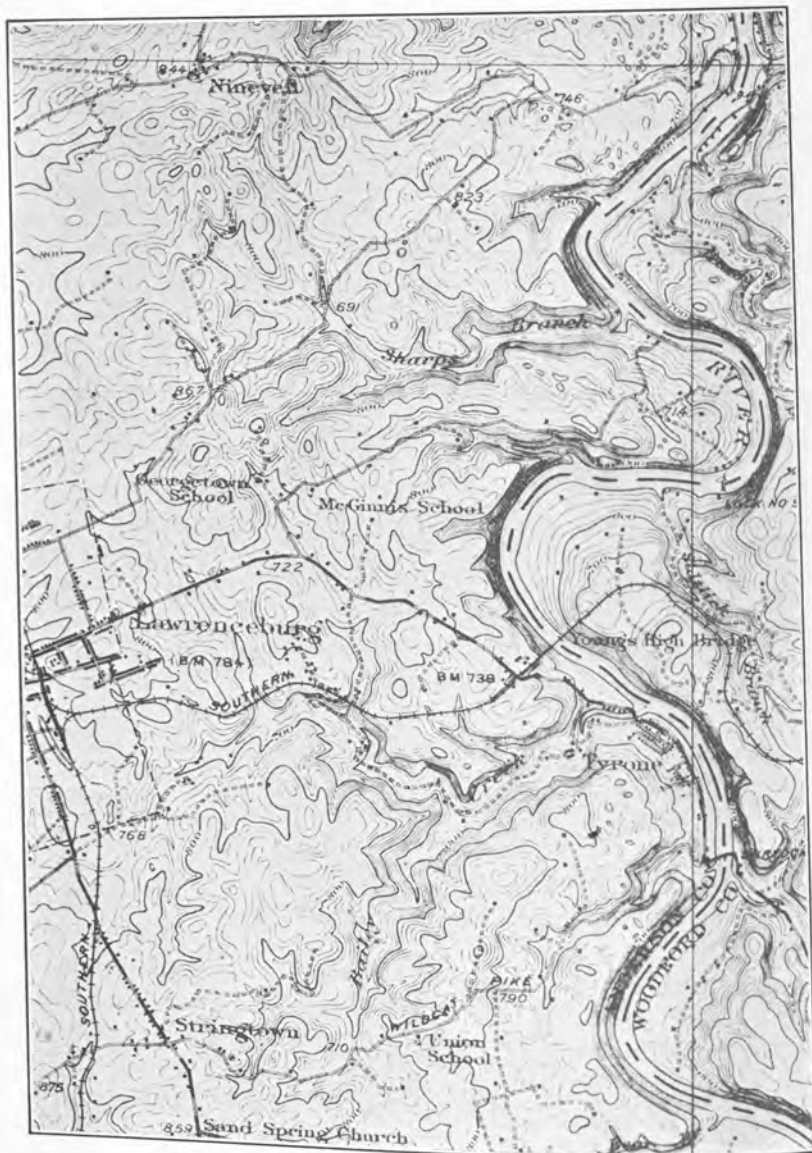
Anderson County is located in the central part of the Bluegrass Region. It contains about 201 square miles. The principal drainage is westward through the North Fork of the Salt River, though the Kentucky River in a gorge bounds the county on the east. The physical aspect of the county varies from rolling upland to hilly along North Fork of Salt River, and rugged adjacent to the deep gorge of the Kentucky River. Lawrenceburg,



A HIGH BRIDGE OF STEEL INTO ANDERSON.
The eastern boundary of this county is the deeply entrenched Kentucky River. This bridge connecting Lawrenceburg with Versailles is owned by the Southern Railroad. It is located just below Tyrone.

the county seat, is 784 feet above sea level, while general elevations range from 480 feet along the Kentucky River to 900 feet on some of the flat ridges.

The high domal position of this county on the Cincinnati Arch produces a normal dip of the rock strata to the west and southwest. The rocks exposed at the surface in Anderson County consist of Ordovician or Bluegrass limestones, shaly limestones and shales. Calcareous beds of Upper Champlainian age are exposed in the bed of Salt River, and in the gorge of the Kentucky River. The uplands exhibit principally the Eden shale. No faults of importance are known to occur in this part of Kentucky.



A PORTION OF THE FRANKFORT QUADRANGLE.
 Eastern Anderson County is deeply cut by the Kentucky River and its local tributaries as shown on this topographical map. West of Lawrenceburg all waters fall into the Salt River.

The principal mineral resources of Anderson County consist of limestones, clays, sands, and gravels. The limestones present a considerable variety ranging from the celebrated Tyrone limestone in type locality, suitable for building and wall construction, to lower grades of slabby field stones which may be used for all general purposes, including highway and railroad bed construction. All of the high grade limestones of this county are suitable for road building purposes, as are some of the creek gravels. Upland "old river" sands of Tertiary age which occur near Alton and elsewhere, as well as the Kentucky River and some Salt River transported sands afford additional inexhaustible deposits. Clays suitable for brick manufacture exist as residual and transported deposits.

A reconnaissance geographic map of Anderson County published in 1924 at the scale of 1:62,500 is available. The topography of this district is about three-fourths completed. The northern half of the county is presented on the Mt. Eden and Frankfort quadrangles, scale 1:62,500, while the southeastern quadrant may be seen on the Harrodsburg sheet, scale 1:125,000.

IV.

BALLARD COUNTY

Ballard County is located in western Kentucky adjoining the lower Ohio and Mississippi rivers. Small in area, containing only 255.91 miles, it is nevertheless typical of the Jackson Purchase Region, of which it is a part. Humphreys, Shawnee, and Mayfield creeks are the principal lines of drainage. The terrain is divided into two easily separated districts: (1) the eastern and central part of the county which is a rolling upland well drained,



CLAY IS A STAPLE MINERAL RESOURCE IN BALLARD.
This view exhibits one of the methods of clay grinding near Wickliffe. Many tons of clay are similarly handled every year in the Jackson Purchase region.

and (2) the westernmost part of the county which is a low lowland dotted with many sloughs and intermittent lakes along the Ohio River. Wickliffe, the county seat, located on an abandoned terrace of the Mississippi River, has an elevation of 331 feet above sea level. Inland elevations range up to about 500 feet, while the low flood plains to the northwest are only about 310 feet above tide.

Western Ballard County in the low lands of the Ohio River just north of its juncture with the Mississippi exhibits upwards of twenty-five elongate lakes or ponds all of small area. Although they are in reality only filled sloughs of the river, their occurrence in Kentucky, a lakeless state, is interesting. The

largest of these old channel lakes is Swan Pond at Haggs Spur on the Illinois Central railroad four miles northwest of Wickliffe. Taken individually or collectively they afford excellent fishing and duck shooting in season.

There are no hard rocks in Ballard County, the formations being all unconsolidated sands, gravels, clays, and alluviums of Tertiary and Pleistocene age. The mineral resources of this county consist principally of gravels, some of which are suitable for concrete construction and road building purposes; clays useful in pottery, brick and tile manufacture, sands for general building construction, and ground water suitable for domestic purposes.

A geographic map of Ballard County published in colors in 1927, scale one inch equals one mile, is available. On this map the flood crest of April 20, 1927, at 327.3 feet is shown as a blue contour. The topography for the northern part of the district is available on the recently surveyed Mound City and Joppa quadrangles scale 1:62,500, with 20-foot contour interval.

V.

BARREN COUNTY

Barren County is situated in central southern Kentucky—the heart of the Pennyroyal Region. Its entire 506 square miles is drained by the Barren and Green rivers. The drainage of the first of these streams comprising the southern and central part of the county is normal—at the surface—while that to the Green



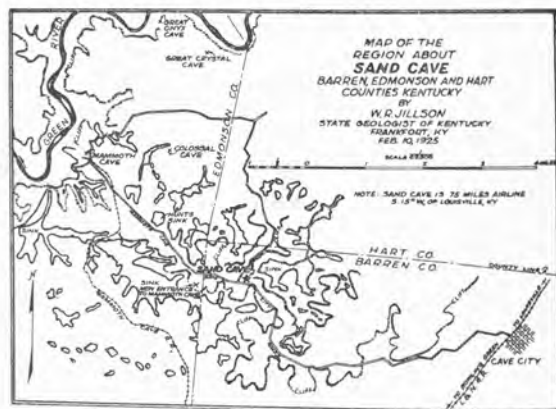
THE DEPP "ANTICLINE."

The Mississippian limestones present a number of pseudo structures like this, one and a half miles east of Elbow springs in Barren County.

River involving all of this county northwest of Oil City and including the important cavern district in the vicinity of Glasgow Junction and Cave City—is subterranean. The surface is rolling to hilly in the southern part of the county, gradually becoming as one proceeds to the north more prairie-like with prominent isolated knobs, and many sink holes. This latter is "Karst" topography. Glasgow, the county seat, has an elevation of 800 feet.

The rocks exposed at the surface range in age from Chester-Upper Mississippian down through the Devonian to the Silurian. They consist entirely of limestones, sandstones and shales.

Located high on the western limb of the Cincinnati Arch, Barren County exhibits a normal dip of its rock strata to the north 45 degrees west. This regular dip of about 30 feet to the mile is interrupted by numerous anticlinal and synclinal folds, many of which are not observable at the surface. Major faults in Barren County are not known to exist.



SAND CAVE AND VICINITY.
Death cavern of Floyd Collins.

The mineral resources of this county consist of limestones suitable for general building, highway and railroad construction purposes. Many interesting caverns are open to public inspection in the neighborhood of Cave City. The southern part of the county exhibits large amounts of creek gravel suitable for road and concrete construction. Large amounts of petroleum and natural gas are also produced in central Barren County, the oil being of high grade coming principally from the Corniferous (Devonian) limestone at shallow depths. In the southern part of the county a few wells have secured oil from stray "sands" in the Silurian and Upper Ordovician strata. Barren County produced during the years 1921 to 1925 a total of 453,253 barrels of oil. A considerable natural gas field has been indexed by a number of good wells near Hiseville.

A reconnaissance areal geological map of Barren County, scale one inch equals two miles, was published in 1919. Following the rather considerable oil development of recent years a detailed oil and gas map in colors was produced in 1925 at the scale of one inch equals one mile. Topography for the western part of Barren County is available on the new Scottsville and Mammoth Cave quadrangles, scaled 1:62,500.

VI.

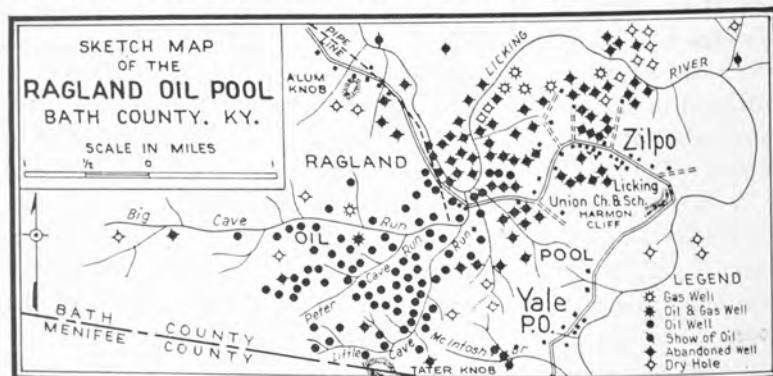
BATH COUNTY

Bath County is located on the eastern flank of the Lexington Dome, its principal drainage being north and northeast through Saltlick, Slate and Flat creeks into the Licking River. It encompasses an area of 294.43 square miles. The northwestern part of the county is included within the outer Bluegrass, while the southeastern part of the county extends into the Knobs. The terrain varies from undulating in the northwest to hilly in the central portion and rugged in the east. Owingsville, the county seat, located on a Silurian capped knob, has an elevation of 1,025 feet above sea level, but elevations of about 600 feet are found along the Licking River in the northern part of the county.

The rocks exposed range stratigraphically from Upper Ordovician limestones and shales in the northwestern part of the county up through the Silurian and Devonian sediments in the central part to the upper Mississippian and occasionally a remnant of the Coal Measures (Lower Pennsylvanian) sandstones near the southeastern boundary.

The principal mineral resources of Bath County are limestone and petroleum. The later has been produced in a large number of wells widely distributed in the eastern part of the county. The most important district is the old Ragland Pool on the Licking River near Yale. Most of the oil is secured from the Corniferous (Devonian) limestone, but some wells near Olympia have produced from the Silurian "sands." The broad belt of exposed Chattanooga black shale may some day be the source of artificial petroleum as it is a very richly bituminous stratum. Limestones suitable for building, highway and railway construction occur in western Bath County, while in the Knobs situated in the eastern part of the county the basal Mississippian sandstone known as "Bluestone" or "Freestone" is available in unlimited quantity for building, foundation, and similar purposes. Transported sands and gravels are available in large quantities along Licking River and elsewhere. Important

deposits of iron ore on Slate Creek (a Devonian siderite) and on Rose Run (a Silurian hematite) have been operated. Continuing and adjacent iron ores may some time under favorable mining conditions be utilized again. Mineral waters of excellent value occur at many points in this county, particularly near Olympia, where they have been commercialized.



SKETCH MAP OF THE RAGLAND OIL FIELD.
This old pool producing from the Corniferous limestone a low gravity black crude has had a remarkable history.

An oil and gas map of Bath County, published in colors in 1927, scale 1 inch equals 1 mile, is available. A small portion of Bath County in the vicinity of Yale is shown on the new Morehead Topographic Sheet, 1:62,500.

VII.

BELL COUNTY

Bell County, typical of the Mountain Region of southeastern Kentucky, adjoins the Virginia and Tennessee State lines. It covers an area of 390 square miles and is drained entirely by the Cumberland River and its principal southern tributary, the Clear Fork. The county is situated southeast of the Eastern Kentucky Geo-syncline and is virtually bisected by the Middles-



FERN LAKE IN THE CUMBERLANDS.

This little lacustrine gem affords a fine water supply for Middlesboro. Pottsville sediments consisting mostly of clastics surround it.

boro Geo-syncline. Cumberland Mountain, exhibiting high angle dips to the northwest, bounds it on the southeast, while Pine Mountain, marked throughout its course by an overthrust fault, bounds the county in part and traverses the northern central portion. Strong dips to the southeast extend from the top of Pine Mountain into the Middlesboro Syncline. The district comprising Bell County is mountainous in the true sense of the word, exhibiting as it does two actual mountains of elevation, the Pine and Cumberland with altitudes ranging from 2,500 feet to 3,350 feet. The altitude of Pineville, the county seat, is 1,025 feet above sea level. Middlesboro, near Cumberland Gap, is about 1,125 feet above sea level.

The consolidated surface rocks of Bell County are all sandstones, sandstone conglomerates, shales and coals deposited during the Coal Measure (Pennsylvanian) period. They are divided into two major divisions: (1) the Pottsville and (2) the



RIDGE MEADOWS IN CHADWELL'S GAP.

Wherever the Lee conglomerate has greatly given away under erosion, gaps such as this at the head of Martins Fork are found in the crest of Cumberland Mountains.

Allegheny. The former are widely distributed, but the latter consist of only a few isolated ridge top outliers on the Log Mountains in the vicinity of Chenoa and Logmont. The entire sequence of the Mississippian limestones, sandstones and shales underlain by the Chattanooga (Devonian) black shale are exposed in the Pine Mountain overthrust fault. The areal extent of these Pre-Pennsylvanian sediments, however, is very elongate and very limited. Alluviums of Tertiary, Pleistocene and Recent age consisting of sands, gravels and clays occur in the stream bottoms, particularly in the Yellow Creek valley near Middlesboro.

The principal resource of Bell County is bituminous coal. Some cannel coal of excellent quality is also available and has been mined for a number of years. Out of a total sequence of at least thirty seams, the following ten: Straight Creek, Mason, Barner, Harlan, Lower Hignite, Dean, Jellico, Poplar Lick, Jack-rock and Winona, are of principal commercial importance. In 1925 Bell County shipped a volume of 2,468,024 tons of coal, and vast areas in this county underlain with commercial coals includ-

ing some cannels are yet undeveloped. Resources of secondary importance in Bell County are limestones along the Pine Mountain Fault suitable for general rural building, highway and railway construction. Sand suitable for general building construction is available as a transported deposit in stream beds and on flood plains; and weathered shale and transported clays may be had for brick manufacture. Petroleum is a remote possibility, while natural gas in small quantities has already been produced



CROSSBEDDED POTTSVILLE SANDSTONES.

These siliceous members of the Lee formation occur at the roadside, strongly cliffed on the east slope of Rocky Face Mountain in Bell County.

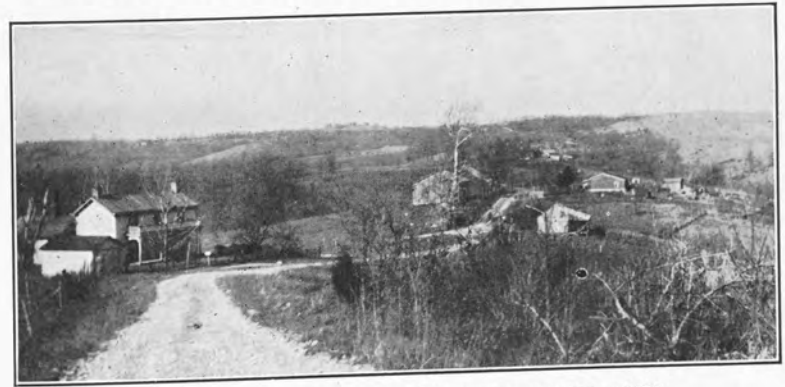
in one or two isolated wells. One of the greatest natural resources of Bell County is the unduplicatable scenery which is now being widely recognized in the vicinity of Cumberland Gap and at Cumberland State Park, at Pineville.

A geological structural map of Bell County contoured on the Dean-Poplar Lick coal, local correlative of the Fire Clay coal, was published in 1928, scaled one inch equals one mile. This district is entirely surveyed topographically as follows: Middlesboro and Hagan sheets, scale 1:62,500; Cumberland Gap Sheet, scale 1:125,000.

VIII.

BOONE COUNTY

Boone County comprising 251 square miles, is situated in northern Kentucky, being bounded on the north and west by the Ohio River and the adjoining State lines of Ohio and Indiana. Its main drainage is confined to three streams, Gunpowder, Big Bone, and Woolper creeks, west flowing tributaries to the Ohio River. The county, though glaciated, is easily recognized as a part of the Outer Bluegrass Region. It exhibits in its central and eastern interior an undulating to hilly upland which to the



GLACIATED UPLANDS NEAR BIG BONE LICK.

Although glacial outwash materials may be found well distributed throughout this area, relatively little modification of the original topography is to be noted. Exceptions to this general rule are, however, notable.

west and south breaks rather sharply into deep ravines frequently rock and gravel filled close to the Ohio River. The normal dip of the strata is to the northwest. The elevation of Burlington, the county seat, is about 848 feet, while the Ohio River six miles distant shows elevations ranging about 430 feet.

The bedded rocks exposed in this county consist of the upper Ordovician limestones, shaly limestones and shales. These comprise about 75 per cent of the area of the county, the remainder being occupied by glacial sands, gravels and silts of Pleistocene age, and alluviums of Pleistocene and Recent age along the southern shore of the Ohio River.

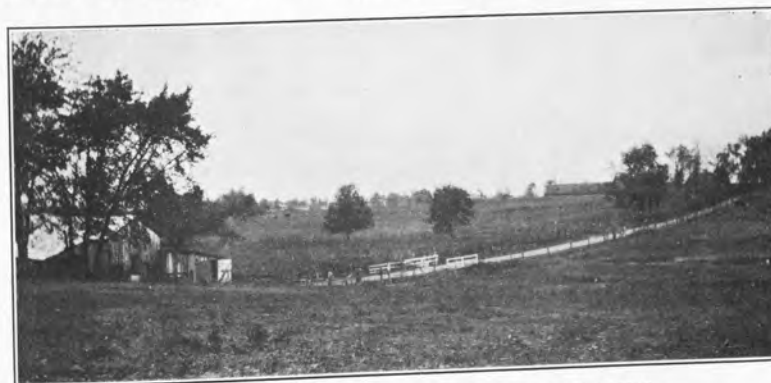
The mineral resources of Boone County consist principally of limestones suitable for use in rough building construction, as road material, railroad ballast and in cement manufacture. Clays along the flood plains of the Ohio River are suitable for brick making. Upland deposits of glacial sands and gravels, as well as those of the Ohio River exist in inexhaustible quantities and are suitable for all purposes including that of metal molding. Big Bone Lick on Big Bone Creek, a westward flowing tributary of the Ohio River in the southern part of the county, is one of the most ancient and celebrated mineral springs in this district. It is of recognized therapeutic value.

A geographic map of Boone County scaled one inch equals one mile is available.

IX.

BOURBON COUNTY

Bourbon County is situated in the central Bluegrass Region and encompasses an area of about 304 square miles. It is drained by the South Fork of the Licking River and its tributaries, Townsend, Houston, Stoner and Hinkston creeks. The terrain of this county for the most part is smoothly undulating though it becomes somewhat flecked with low hills in the northern part along the Licking River. Paris, the county seat, is 865 feet above sea level, a rather average elevation, altitudes for the



UNDULATING BOURBON COUNTY FARMLANDS.

This view on the county pike east of Paris leading to Millersburg is typical of the country between Hinkston and Stoner creeks.

entire county ranging from 725 on Licking River near the Harrison County line to 1010 feet on the dividing ridge between this and Fayette County.

Though well within the Inner Bluegrass Region, the normal dip of the bed rock is to the southeast. The rocks exposed in Bourbon County consist of limestones, shaly limestones and shales of the Ordovician series. The heart of the county centering about Paris on Stoner, Houston, and Townsend creeks, as well as the northern Licking River, shows the Lower Ordovician highly phosphatic limestones classified as Champlainian. The balance of the county exhibits the higher rocks in this series known as the Cincinnati or Upper Ordovician rocks.

The mineral resources of first importance in Bourbon County are limestones. These occur in abundance and are suitable for all grades of general rural building, highway and railroad construction. Residual clays in the uplands and transported clays along some of the streams are suitable for ordinary brick making. The county is traversed by the well defined Bryant's Station Fault which crosses the southwest boundary near Muir, and proceeds northeastward along Houston Creek waters slightly west of Paris.

An areal geological map of Bourbon County, scale one inch equals one mile, is available. Detailed topography for the western part of this district is available on the Lexington and Cynthiana quadrangles, scale 1:62,500. The topography for southeastern Bourbon County is now being surveyed at the same scale on the Austerlitz Quadrangle.

X.

BOYD COUNTY

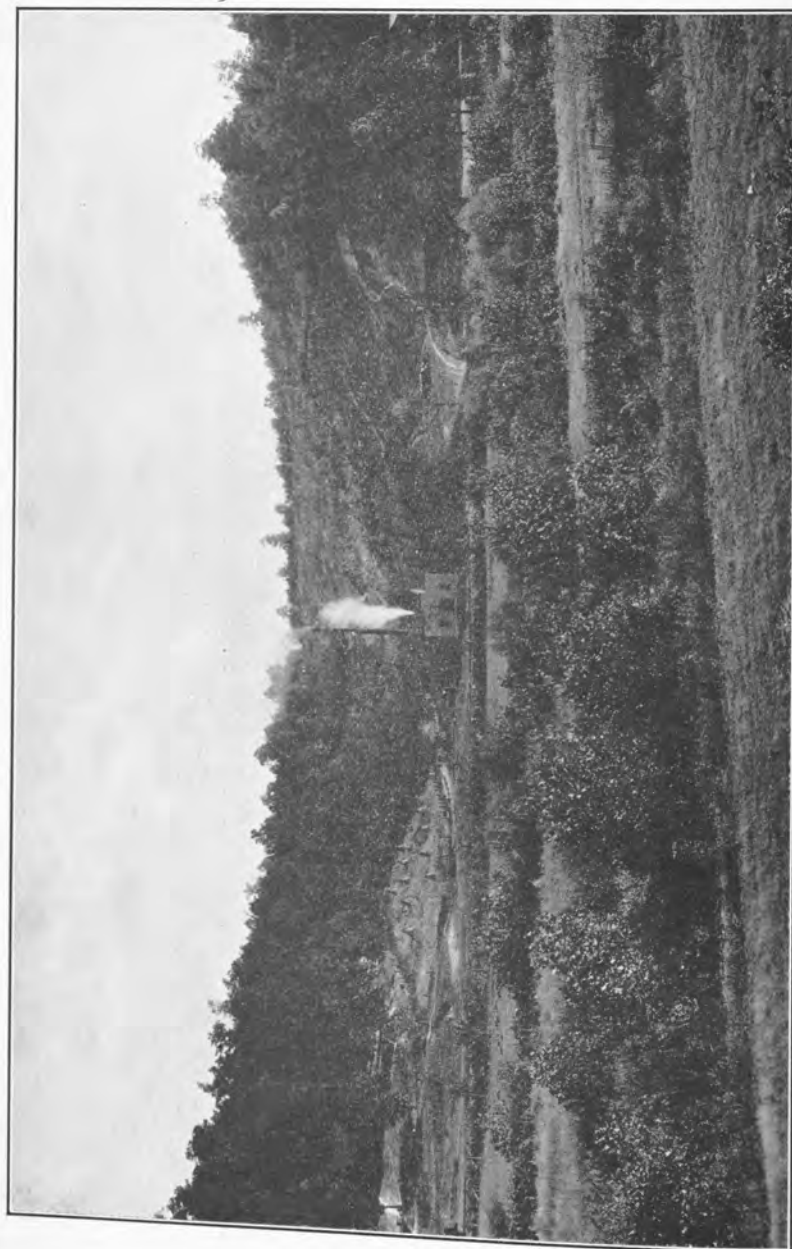
Boyd County is located in northeastern Kentucky adjacent to the Big Sandy and the Ohio rivers, and the states of West Virginia and Ohio. It has an area of about 159 square miles. An integral part of the Eastern Kentucky Coal Field, its terrain is very hilly, level land being confined entirely to restricted bottoms of limited extent along the principal lines of drainage. Ashland and Catlettsburg have elevations of 550 feet above sea level, while winding ridge lands rise from about 800 feet in the north to about 1100 feet in the southern part of the county.



JESSE HORN NO. 1 GASSER NEAR ASHLAND.

Commercial production of natural gas in the Ashland district is derived mainly from the Ohio black shale of Devonian age. This formation occurs at depths ranging from 1300 to 2500 feet and is generally about 650 or 700 feet in thickness.

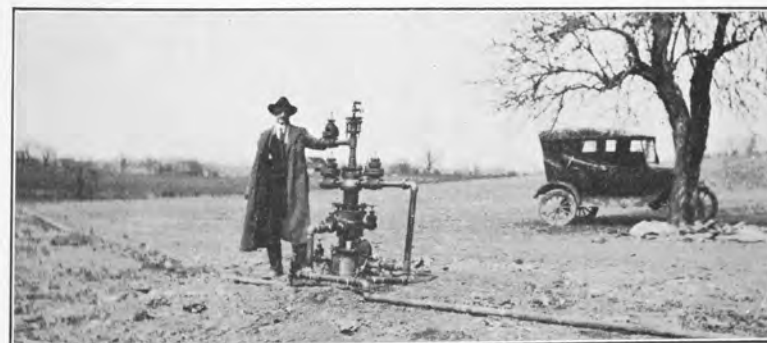
The hard rocks exposed at the surface consist entirely of sediments of Coal Measure (Pennsylvanian) age, sandstones, shales, and coals. These are divided stratigraphically into three major groups: (1) Pottsville, (2) Allegheny, and (3) Conemaugh. Alluviums of Pleistocene and Recent age occur in stream bottoms and along the Ohio River. Upland stream gravels of Pleistocene age also occur in the northeastern part of the county. The normal dip of the rocks is to the southeast into



A BOYD COUNTY COAL MINE. This view shows the operation of the Big Run Coal Company located on the Midland trail in the western part of the county. While bituminous coal will always be one of the major resources of this district, its production has decreased in recent years due to the extensive operation of greatly superior coals found at the headwaters of the Big Sandy River.

West Virginia. This dip is interrupted at many points by numerous anticlinal, doming and synclinal folds. Faults of major significance are not known to occur in Boyd County.

The most important mineral resource of Boyd County is coal, about ten recognized seams being present, and of these five are of commercial significance, having been operated at a number of points. These are: Lower Freeport, Middle and Lower Kitanning, and Upper and Lower Mercer coals. In the year



AN EXCELLENT BOYD COUNTY GASSER.

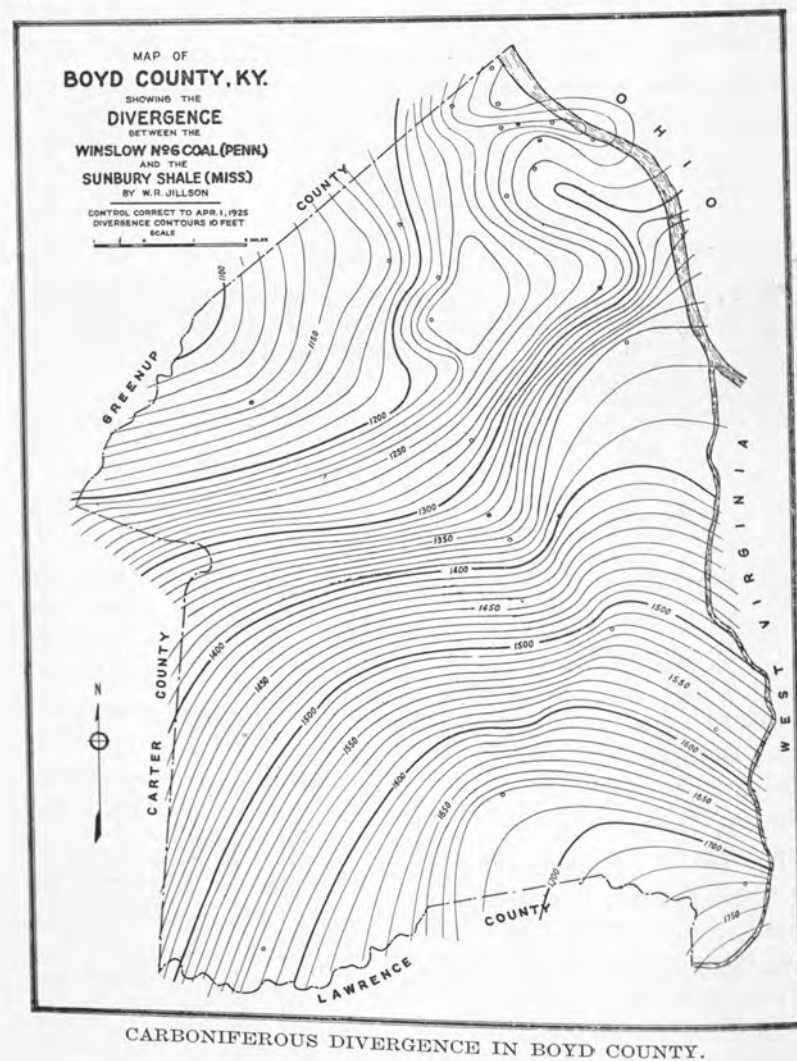
This is the J. F. Mason No. 1 well located 1 mile south of Summit Station. It produced from the Salt Sand, Big Injun, and Ashland Gas Sand. The late John G. White, one of the ablest operators of Eastern Kentucky, who drilled it, stands beside the well.

1925 Boyd County produced 45,234 tons of bituminous coal. Oil and gas sands of commercial significance producing natural gas in large quantities are found in the subsurface section, the principal commercial production coming from "sands" in the Devonian black shale and the "Corniferous" limestone in the Ashland Gas Field. The "Salt" sand (Pennsylvanian), the "Big Injun," and the "Berea" sands (Mississippian) are also producers. Petroleum has been produced in a number of wells, but up to the present has been of secondary importance.

Transported Pleistocene sands occurring as old terrace deposits along the Ohio River are found in commercial quantity suitable for coring, molding and general construction purposes. Transported clays and residual shales suitable for brick and tile manufacture as well as Coal Measure plastic fire clays are widely distributed and operated at a number of points in this county.

Carbonate iron ores were formerly operated extensively in Boyd County—a part of the well known Hanging Rock “district.”

Structural geological, oil and gas, and topographical maps of Boyd County are available. The former are scaled 1:62,500 while the latter presented on the Kenova Sheet is scaled 1:125,000.



XI.

BOYLE COUNTY

Boyle County, exhibiting both a Bluegrass and Knobs landscape, is located in central Kentucky on the top of the Cincinnati Arch. It covers an area of 185.76 square miles. The physical aspect of the county varies from an undulating limestone plateau on the north to a rugged knobby region on the south. The eastern part of the county close to the waters of Dicks River



HERRINGTON LAKE.

This beautiful body of water fills the former gorge of Dicks River and bounds Boyle on the east.

is deeply trenched by erosion and precipitously rugged. Danville, the county seat, has an elevation of 989 feet, but the vertical local relief varies from 150 to 300 feet below and above this elevation. Bottom lands in Dicks River, now flooded by the dam, are 610 feet above sea level at the mouth of Harrods Branch in the northern part of the county, while ridge tops on the Casey and Lincoln County lines attain actual elevations of about 1400 feet above tide.

The rocks of Boyle County range from Lower Ordovician limestones and shales up through the Devonian limestones and Chattanooga black shale to the Lower Mississippian calcareous sandstone. Silurian beds are absent. The normal dips in the



OIL SHALE AT JUNCTION CITY.
This outcrop of the Chattanooga Devonian black shale occurs on the Louisville and Nashville Railroad within the town corporation limits.

county are to the south and are flat north of Danville, but become very steep south of this city as one approaches the Knobs. The eastern tip of the county is traversed by the important Burdette Knob Fault Zone. An important line of faulting and folding also extends westward from the vicinity of Elm Grove School on Balls Branch along the northern base of the Knobs.

The mineral resources of Boyle County consist principally of limestones and shales. The limestones are of Ordovician age and are suitable for all general purposes of rural building construction, and also as highway and railway roadbed material. Residual clays on the uplands might be used for brick making and the New Providence (Lower Mississippian) green shale and clays in the vicinity of Junction City and westward to Mitchellsburg are suitable for brick and tile manufacturing purposes.

A geographic map of Boyle County published in 1926 to the scale of one inch equals one mile is available. The topography for most of the county, scale 1:125,000, has been presented on the Harrodsburg Sheet. A new reconnaissance geological map of Boyle County has been surveyed at the scale of 1 inch equals 1 mile. It will be issued during 1929.

XII.

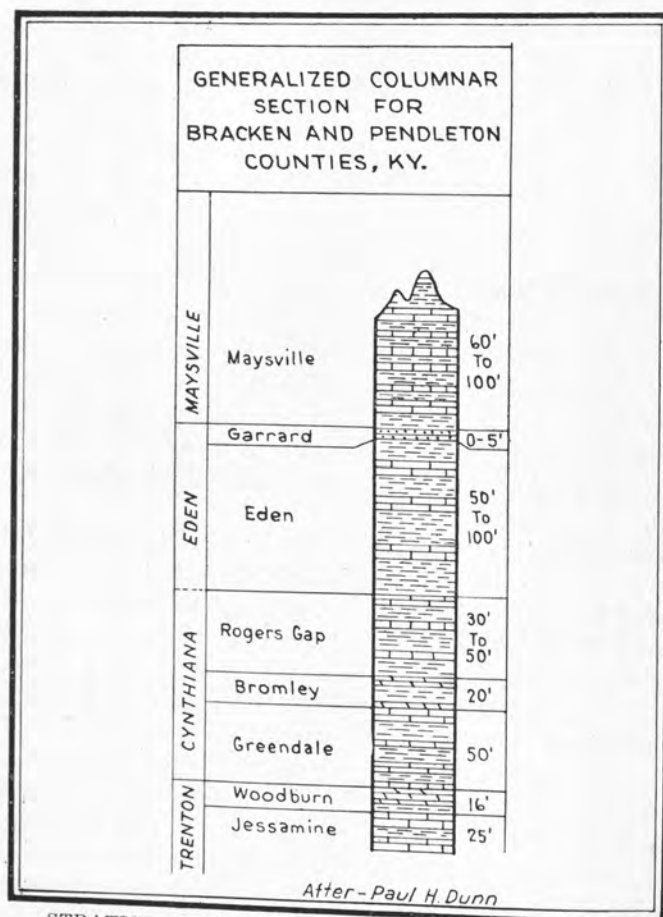
BRACKEN COUNTY

Bracken County is located in the northern part of the Outer Bluegrass Region of Kentucky adjacent to the Ohio River and State of Ohio. It encompasses about 204 square miles. The physical aspect of the county is hilly throughout, there being only limited areas of flat alluvial lands along the Ohio and the North Fork of the Licking River. An undulating upland constitutes the divide between the Ohio and Licking rivers. Brooksville, the county seat, is 925 feet above sea level, while lowlands along the Ohio exhibit a minimum relief of about 480 to 500 feet.

The rocks in Bracken County consist of Upper Ordovician limestones, shaly limestones and shales throughout, with the exception of areas of Pleistocene and Recent alluvium in the bottoms of the larger interior streams and along the Ohio River. The normal dip of the rocks is eastward away from the axis of the Cincinnati Arch. The county is unfaulted in so far as is known.

The mineral resources of Bracken County consist principally of limestones which are broadly distributed and suitable for rural building, highway and railway construction. Some considerable deposits of residual clays in the uplands might be used for brick manufacture as could some of the transported clays of the Ohio River Valley. These might also be used in conjunction with some of the limestones in this portion of the Ohio River as cement manufacturing materials. Sands and gravels suitable for general constructional and concrete making purposes are available from the Ohio River. In the southeastern part of Bracken County a few shallow wells have produced small amounts of oil from "stray" sands in the Upper Ordovician series.

A geographic map of Bracken County dated 1926 and scaled one inch equals one mile is now available. This district as a unit is unsurveyed topographically, but the fractional Higinson and Felicity sheets, scaled 1:62,500 have been completed in the field and will in the near future portray that part of the county touching upon the Ohio River.



STRATIGRAPHIC SECTION FOR BRACKEN COUNTY.

XIII.

BREATHITT COUNTY

Breathitt County is situated in the central part of the Eastern Kentucky Coal Field. It covers an area of 350.61 square miles. Physiographically it is a part of the "Mountain Country" although it exhibits no great elevations nor is there great relief in this part of the State. The region is one of mature dissection, the county being traversed by the North and Middle Forks of the Kentucky River. Quicksand and Troublesome



FOSSILIFEROUS SHALES AT COPELAND.

These beds exhibit a similar fauna and may be a direct correlative of the Kendrick shale found in type locality on Cow Creek in Floyd County.

creeks are important westward tributary drainage courses flowing into the North Fork. Jackson, the county seat, somewhat above the North Fork flood plain, has an elevation of 791 feet above sea level, while ridge top elevations in the southeastern part of the county attain 1530 feet as compared to minimum elevations along the North Fork of the Kentucky River of about 690 feet at the Lee and Wolfe County line.

The surface rocks of Breathitt County consist of an alternating series of sandstones, shales and coals all of which are of Pottsville (Lower Pennsylvanian) age. The normal dip of the bedded rocks in the northwestern part of the county is to the southeast, but elsewhere dips are local in response to the in-

fluence of the Eastern Kentucky Geo-syncline which passes in a great loop through the southeastern part of the county. There are no faults of consequence in Breathitt County.

The principal mineral resources of Breathitt County are coal and natural gas. In this district there are about seven seams, of which the following three (1) Fire Clay or No. 4 coal, (2) Whitesburg or No. 3 coal, and (3) Flag or No. 7 coal, are of commercial importance. In 1925 Breathitt County produced 177,029 tons



FOSSIL FERNS FROM BREATHITT COUNTY SHALES.

of coal. Natural gas has been developed on the waters of Frozen Creek in the northern part of the county and indexed in a number of other wells. Petroleum is a distinct possibility in the "Corniferous" (Devonian) sand. Commercial oil has been produced in small quantity from the "Corniferous" in the northwestern part of this county near the Wolfe County line. Sandstones suitable for rough and rural building, bridge abutment and other similar purposes occur in this district. Loose sands suitable for cement and concrete construction occur in the beds of the North and Middle Forks of the Kentucky River.

A geologic structural oil and gas map of Breathitt County dated 1927 is now available. Structural and stratigraphic sections are presented on this map. The topography of Breathitt County is shown on the Beattyville, Manchester and Salyersville quadrangles, scaled 1:125,000; and the Buckhorn and Troublesome quadrangles, scaled 1:62,500.

XIV.

BRECKINRIDGE COUNTY

Breckinridge County is situated in northwestern Kentucky adjacent to the Ohio River and the State of Indiana. Its entire area—568 square miles—is drained by the waters of the Rough and Ohio rivers and their tributaries. The rolling terrain in the northeast is marked by many sinkholes and some isolated knobs. Broad "sinking" valleys are not uncommon. In the southwest the county is hilly and in some localities along the



THE FALLS OF ROUGH RIVER.

This stream forms the natural boundary of Breckinridge and Grayson counties. A series of rapids and shoals in this part of its course unfit it for navigation.

Rough River and its tributaries it is precipitously rugged. The dividing ridge on which Hardinsburg is located at an elevation of about 700 feet is a remnant of a once broad upland of considerable extent.

The surface rocks of Breckinridge County consist entirely of sediments—limestones, sandstones and shales. Coal Measure ridgetop outliers of small extent occur near the Hancock line in the western part of the county, the balance of the county being represented principally by the Chester formation. Rocks of the Upper Meramec group, the Fredonia and St. Louis limestones (Lower Mississippian) outcrop near Irvington and on

Sinking Creek, and Galameser Creek. The normal structure of the county interrupted by some rather extended folding plunges to the southwest at about 30 feet to the mile.

The mineral resources of Breckinridge County consist of limestones suitable for all general purposes of building construction and cement making, and for use as highway and railway



KARST TOPOGRAPHY IN BRECKINRIDGE.

This view shows a panorama of the Sinking creek valley from Adams Hill. This dissected plateau is carved in Chester rocks largely limestones of high solubility.

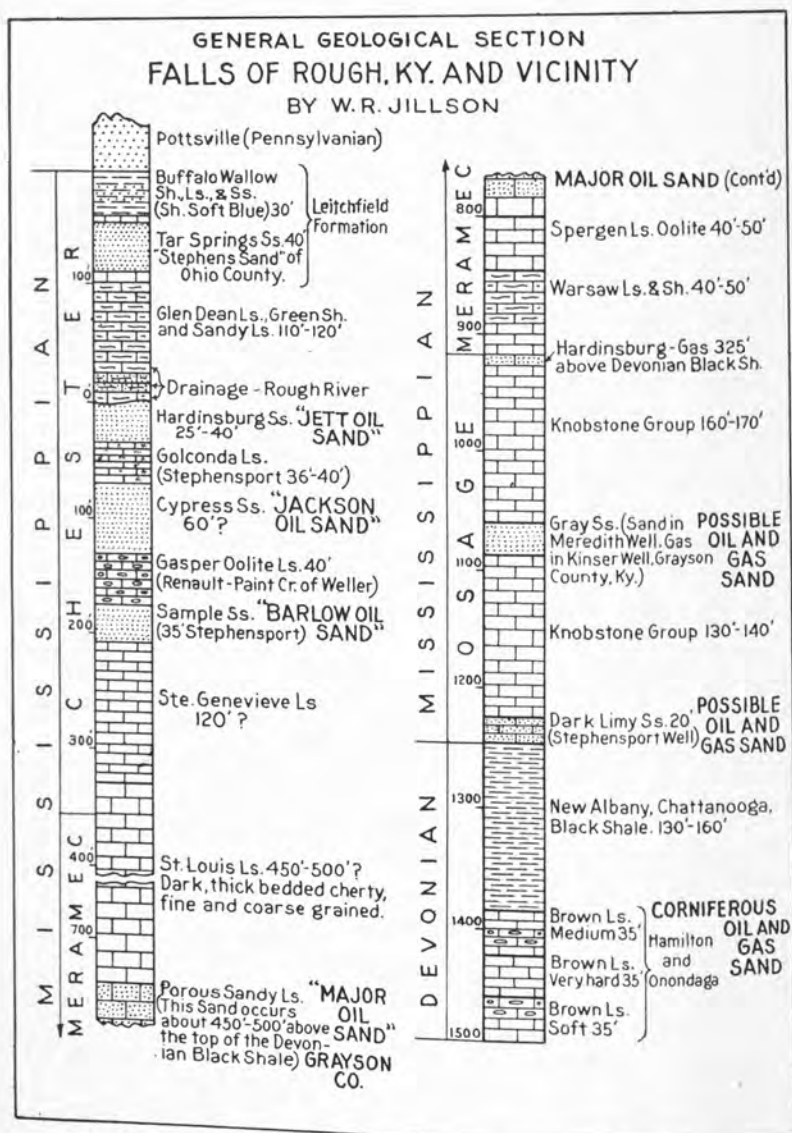
materials. Breckinridge County is rich in bituminous sandstone known to the trade as rock asphalt. The asphaltic beds are the Tar Springs and Cypress (Chester) sandstones. Open pitted prospected properties and producing operations extend in a broad belt from Cloverport through Garfield into Hardin and Grayson counties on the southeast. This county has also an inexhaustible supply of both residual and transported clays suitable for brick, tile and cement manufacture. Oil has been secured in a number of wells in Breckinridge County and natural gas has been produced and used in the vicinity of Cloverport from the Chattanooga (Devonian) black shale for many years. Cannel coals were formerly produced from an unusually fine deposit near the Hancock County line.

An old reconnaissance map of Breckinridge County is available. The topography of only a part of the county is completed, though the entire district is now in process of field surveys. The Hardinsburg and Big Clifty sheets scaled 1:62,500 are now ready for distribution.



A TYPICAL BRECKINRIDGE COUNTY LIMESTONE QUARRY.

This opening in Chester beds is known as the Adams quarry. It is located eleven miles northeast of Hardinsburg. Thirty feet of good road material is available here, and similar sections are available at many other points in this region.



STRATIGRAPHIC SECTION NEAR FALLS OF ROUGH CREEK
During the past two years there has been considerable activity in oil and gas prospecting in both Breckinridge and Grayson Counties. This section showing oil and gas sands was prepared following field investigations to aid in this exploratory work.

XV.

BULLITT COUNTY

Bullitt County is situated in central northern Kentucky closely adjacent to the Ohio River. It is drained by Salt River and its tributaries. The county covers an area of 308 square miles and is hilly throughout, being located entirely within the Knob Belt. Shepherdsville, the county seat, attains an elevation of 446 feet above which, hills, many of which are isolated, rise 200 to 400 feet.

The hard surface rocks of this county are composed entirely of sediments of Lower Mississippian, Devonian, Silurian and Upper Ordovician age, the same being sandstones, limestones and shales. Alluviums of Recent and Pleistocene age occur in the bottoms of Salt River and its larger tributaries. Located at a point low on the western flank of the Lexington Dome of the Cincinnati Arch the normal dip of the rocks intercepted by some minor folding is westward. No faults of importance are known to exist in this county.

The principal mineral resources of Bullitt County are limestones and shales. The limestones occur principally in the eastern part of the county whereas the residual shales and transported clays suitable for brick and tile manufacturing purposes occur in the Lower Mississippian belt and along the stream courses in the western part of the county. Through the central interior along a north and south line generally, the Chattanooga (Devonian) shale extends as a belt, and this may some time be utilized in the manufacture of artificial petroleum and other mineral products. Oil and gas in small quantities have been found at a number of points in western Bullitt County.

A new geographic map of Bullitt County is available, and detailed modern topography, scaled 1:62,500 for the northern part of the county, has been presented on the Kosmosdale and Louisville sheets.



THE CHATTANOOGA BLACK SHALE.

This view of the kerogenitic Devonian shale is one of several cuts on the Louisville and Nashville Railroad a short distance north of Shepherdsville, Ky.

XVI.

BUTLER COUNTY

Butler County is situated in western central Kentucky. It covers an area of 444.8 square miles and is drained by the Green River and its tributaries including Mud River. The county is located entirely in the Western Kentucky Coal Field, with the exception of the southern triangular tip which is in the Pennyroyal. Morgantown, the county seat, on the Green River, has an



GREEN RIVER AT THE MOUTH OF REEDY CREEK.

At this point the master stream of the Western Coal Field is threading a meandering course between white cliffs of Mississippian limestones which are overlain by sandstones of Coal Measure age. The latter are frequently asphaltic.

elevation of 573 feet. The region is hilly throughout and the southeastern section adjoining Green River is somewhat rugged.

The hard surface rocks of Butler County are entirely limestones, sandstones, shales and coals of Upper Mississippian (Chester) and Lower Pennsylvanian (Pottsville and Allegheny) age. Alluviums consisting of sands, gravels and clays occurring along the bottoms of the Green River and its principal local tributary are of the Pleistocene and Recent age. Bisected by the Western Kentucky Geo-syncline, the normal structure of the northern part of the county is inclined to the south of west, while that of the southern part of the county is about north 15

degrees west. Several generally east and west normal faults have been mapped in this district.

The principal mineral resource of Butler County is coal. Due to the fact, however, that this county has no railroad, there are but few operations, the seams being worked chiefly for local or domestic consumption. Oil and gas in commercial quantities undoubtedly exist in this county as these minerals have been produced from sands at drillable depths in all adjoining counties. Asphaltic sandstones of Pottsville age known as rock asphalt occur in the southeastern part of the county adjacent to Green River and elsewhere. Limestones suitable for the purposes of general building, highway and railway bed construction occur in the southeastern part of Butler County. Alluvial clays in the stream valley flood plains are available for brick manufacture. Residual clays and shales occurring in the uplands might also be used for this purpose. Occasional deposits of residual sands are available for general construction purposes.

An excellent geological map of Butler County is now available, and separately a new oil and gas and pipe line map in colors, scale 1:62,500, has recently been published. The topography has been presented on the Hartford, Spring Lick, Brownsville, Little Muddy and Dunmore quadrangles, scaled 1:62,500.

XVII.

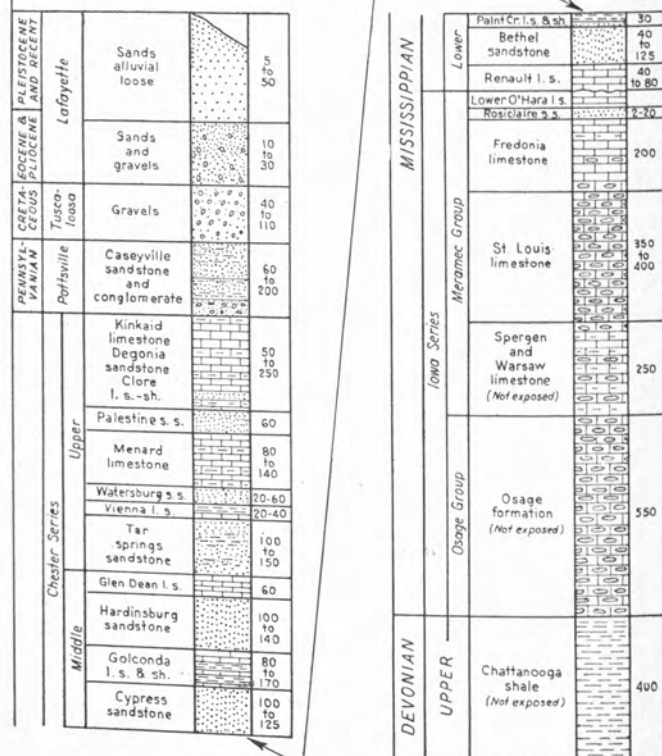
CALDWELL COUNTY

Caldwell County is located in western Kentucky and is drained by the Cumberland and Tradewater rivers and their local tributaries. It covers 358.61 square miles. The eastern part of this county embraces a part of the rim of the Western Coal Field, while the western three-fourths of the county is included within the Western Kentucky Pennyroyal. Princeton, the county seat, has an elevation of 488 feet. The surface of the country surrounding, rising to about 750 feet above sea level, ranges from rolling to hilly with many isolated knobs and a very considerable sink hole or Karst area of subsurface drainage.

The normal dip of the rocks of this county is to the northeast into and under the Western Kentucky Coal Field. Due, however, to a large amount of principally normal faulting generally of an east and west, and northeast and southwest strike, but with some notable transverse exceptions, there are many dips of high angle in variance with the regional structure as indicated above. The rocks of Caldwell County consist of Pottsville (Lower Pennsylvanian), Chester and Upper Meramec (Mississippian) limestones, sandstones and shales. The occurrence of a single igneous peridotite dike about 7 miles northeast of Princeton has been noted. Alluviums of Recent and Pleistocene age compose the flood plain of the Tradewater River and its major tributaries in this region.

The principal mineral resource of Caldwell County is limestone which occurs in requisite quality and quantity for general and specific building, highway and railway bed construction. Some coal occurs in northeastern Caldwell County, but this resource is of minor significance. Small amounts of oil and gas are known to have been produced in this district, but these minerals have never been found in commercial quantities. Fluorspar, CaF_2 , has been produced along several of the mineralized faults, particularly northwest of Princeton in the vicinity of Crider. Many of these faults show deposits of calcite too small to be of commercial value. Common ores of lead and zinc are

GENERALIZED GEOLOGICAL
SECTION FOR
WESTERN CRITTENDEN, LYON,
LIVINGSTON, TRIGG AND
CALDWELL COUNTIES, KY.



STRATIGRAPHIC SECTION IN CALDWELL COUNTY.

also frequently found but in unworkable quantities. Clays of residual type suitable for ordinary brick making are present.

A good geological map of Caldwell County, dated 1927, showing structural and stratigraphic sections is now available. The topography for the greater part of the county is presented on the Eddyville, Princeton, Providence and Dawson Springs quadrangles, scaled 1:62,500.

XVIII.

CALLOWAY COUNTY

Calloway County, typical of the Jackson Purchase Region of which it is a part, is located in western Kentucky adjoining the Tennessee River on the west. It covers an area of 412 square miles. The Tennessee State line forms its southern boundary. It is drained by the East and West Forks of Clarks River flowing northerly, and Blood and Jonathans creeks, northeast flowing tributaries of the Tennessee. A small amount of the drain-



GRAVEL ROAD IN EASTERN CALLOWAY.

An abundance of creek and river gravels as well as residual beds principally of Cretaceous age are available for road use in this region.

age in this county goes westward into Obion River. The terrain of the county is divisible into two major units, (1) a gently rolling upland in western Calloway on the headwaters of Clarks River, and (2) the rough and irregular "Breaks" of the Tennessee River and the lower drainage of Blood and Jonathans creeks adjoining. Murray, the county seat, has an elevation of 475 feet which is but slightly below the average in the county. Upland elevations along the Tennessee line rise to about 600 feet above sea level in the "Flatwoods" district, while the flood plain of the Tennessee near the Marshall County line is about 350 feet high.

The rocks exposed at the surface consist principally of marine Eocene and Pliocene sands, clays and gravels, though

in the eastern part of the county Recent and Pleistocene alluviums are found in the flood plain deposits of the Tennessee and its lower tributaries. In the vicinity of New Concord and northward on Blood Creek, Cretaceous sands, clays, gravels and some lignites of Ripley, Eutaw, and Tuscaloosa age are exposed by the dissection, while underlying these, St. Louis (Mississippian) cherty limestones are found adjacent to the Tennessee River. Aside from the small areas of exposed St. Louis limestones in the eastern part of Calloway County there are no hard or bedded rocks in this part of Kentucky exposed to the surface. Drilled wells, however, reveal the fact that the surface formations as well as those underlying plunge rapidly to the southwest, the normal dip being about 30 feet per mile. Due to the extensive covering of unconsolidated sands, gravels and clays at the surface, the exact nature of the structural geology and the fault pattern of this county is not open to detailed investigation and record. It is doubted if much definite information will ever be secured concerning this phase of the county's geology. It is reasonable to suppose, however, that in keeping with that part of Kentucky immediately to the northeast—Trigg, Lyon and Livingston counties—much of Calloway as well as adjoining counties in the Purchase are more or less complexly faulted. Based upon a single instance in southwestern Trigg County in which Cretaceous sediments are involved, it is logically held that part of this faulting and folding must have been post-Cretaceous, possibly Eocene in age.

The chief mineral resources of Calloway County are sands, gravels, and clays. The sands are suitable for general building construction purposes, as are also the gravels which in addition are used largely for road and railroad bed building materials. The clays of Calloway County, aside from general purposes of brick manufacture, are suitable in some deposits for stoneware, ball and sagger work, and for these purposes have had some development particularly for domestic pottery.

A new geographic map, scale 1:63,360, of Calloway County showing the location of developed resources is now available. An older geological map, scale 1 inch equals 2 miles, exhibiting Calloway as a part of the entire Jackson Purchase may also be secured.

XIX.

CAMPBELL COUNTY

Campbell County is located in northern Kentucky between the Ohio and Licking rivers adjacent to the State of Ohio. Although glaciated to a considerable extent the county is quite typical of the Outer Bluegrass Region. It covers an area of about 145 square miles. Alexandria, the county seat, has an elevation of 850 feet which is representative of the uplands or dividing



THE LICKING RIVER AT LOW TIDE.
This view taken in southern Campbell County indicates how diminutive this stream may become during dry periods.

ridge region between the Ohio and Licking rivers. Flood plain elevations in the Licking and Ohio rivers range from about 460 to 480 feet above sea level.

The hard surface rocks of this county consist of limestones, shaly limestones and shales of the upper Ordovician series. Restricted areas of Recent and Pleistocene alluviums are found on the flood plains of both the Ohio and Licking rivers. Located structurally on the crest of the Cincinnati Arch on the north flank of the Lexington Dome this county exhibits generally a northeast dip. It is not faulted so far as is known.

The mineral resources of Campbell County are confined to limestones suitable for general rural building, highway, and railroad bed construction purposes. Some of the Ordovician lime-

stones of Campbell County may be used to advantage with proper clays for cement manufacture. Sands and gravels in the Ohio River constitute an inexhaustible supply for purposes of general construction and highway building.

A geographic map, scaled one inch equals one mile, of Campbell County is available. The topography of the northern part of the county has been executed on the Cincinnati double sheet to a scale of 1:62,500.

XX.

CARLISLE COUNTY

Carlisle County is located in western Kentucky adjoining the Mississippi River and is typical of the Jackson Purchase Region of which it is a part. This county covering an area of about 198 square miles, is drained by Mayfield Creek and Skaggs Creek, westward flowing tributaries of the Mississippi. Bardwell, the county seat, has an average elevation of 393 feet, but somewhat higher elevations are found to the east in the vicinity of Milburn



LOWER WATERS OF MAYFIELD CREEK.
During the dry periods of the late summer and fall this stream trenched into Tertiary sands and gravels is very inactive.

and along the Graves County line. Physiographically the county is divisible into two units. Most important of these is the upland area which constitutes practically the entire country east of a meridian passing through Laketon. West of this Meridian are the low bottoms of the Mississippi River.

The surface rocks of Carlisle County consist of marine Eocene and Pliocene sands, gravels and clays, all occurring in upland areas. These are overlain with a blanket of Pleistocene silty loess over a belt about 6 miles wide eastward from Laketon. The bottoms of the Mississippi River are composed of alluviums

of Recent age. The normal structure of the unconsolidated deposits of this county as revealed by well drilling is to the southwest at about 30 feet to the mile.

The principal resources of Carlisle County are confined to sands, gravels, clays, and artesian water. The sands are suitable for general purposes of building construction. Gravels are used for highway and railway bed construction, while undeveloped clays in localized deposits are present, suitable for general purposes. Some artesian water has been produced for domestic use from the Lagrange (Eocene) sands.

A geographic map scale one inch equals one mile is available. No topography has been executed for this county, but the county is shown on a large geological map of the Jackson Purchase, scale one inch equals 2 miles.

XXI.

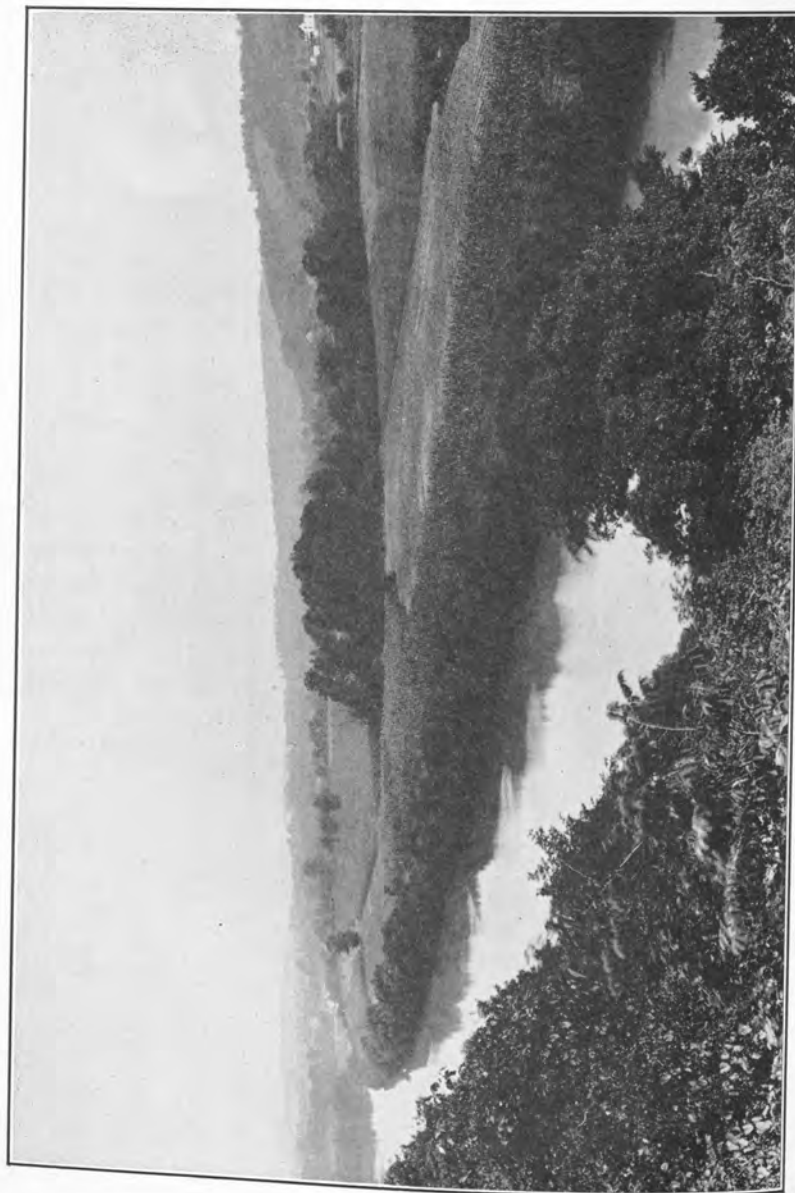
CARROLL COUNTY

Carroll County is situated in northern Kentucky adjacent to the Ohio River and State of Indiana. It covers an area of about 132 square miles. The northern portion of the county has been glaciated by the Pleistocene ice sheet, and glacial outwash has undoubtedly covered the remainder to Eagle Creek on the south, but it is nevertheless easily identifiable as a part of the Outer Bluegrass Region of Kentucky. Carrollton, the county seat, situated at the mouth of the Kentucky River on the flood plains of the Ohio, has an elevation of 475 feet. The interior elevations rise to 300 feet above low water in the Kentucky and Ohio rivers. The ridges are very narrow and winding, and the stream valleys are constricted and meandering indicating mature dissection.

The hard surface rocks of Carroll County are composed entirely of limestones and shales of the upper Ordovician series. Alluviums and glacial till consisting of sands and gravels, and silts of Recent and Pleistocene age are found in all of the flood plain deposits of Eagle Creek, the Kentucky and Ohio rivers. Upland glacial deposits are also widely distributed, including an occasional Canadian quartzite boulder of large size. The normal regional structure of the county, situated on the northwestern flank of the Cincinnati Arch, is to the northwest.

The principal mineral resources of Carroll County are limestones, sands and gravels; the first being obtainable from the bedded country rocks of the county, the latter as transported deposits along the Kentucky and the Ohio River. Some upland glacial sands and gravels may eventually be found to be of commercial value. All of these resources are available in significant quantities. Both oil and gas in small quantities producing from upper Ordovician "sands" are reported from shallow wells in the eastern part of Carroll County.

A geographic map of Carroll County is available in connection with a similar map of Gallatin County. The region is not surveyed topographically. A new geological map in colors is now being prepared for Carroll County to the scale of one inch equals one mile and will soon be available.

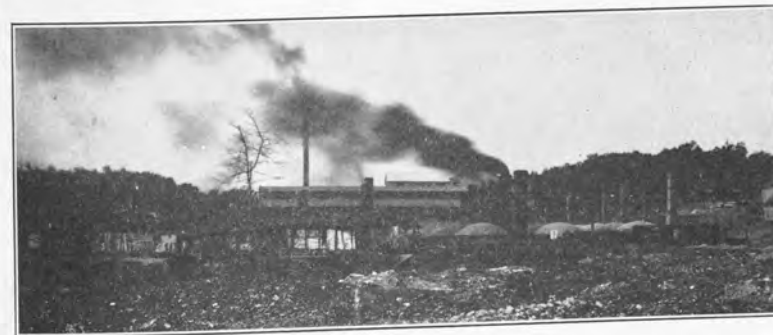


THE KENTUCKY RIVER VALLEY IN CARROLL COUNTY.
Upper Ordovician rocks are broadly entrenched in wide meanders by this stream as one approaches the Ohio.
Excellent farm lands supported by transported soils abound.

XXII.

CARTER COUNTY

Carter County, encompassing 413 square miles, is located in northeastern Kentucky. Physiographically and geologically it is a part of the Mountain Region. It forms a part of the maturely dissected Allegheny Plateau and is drained by the waters of Tygarts Creek and Little Sandy River. Grayson, the county seat, on an old river terrace, has an elevation of 685 feet, but ridge elevations existing in this county attain heights ranging from 850 to 1000 feet.



OLIVE HILL FIRE BRICK PLANT.

This operation of the General Refractory Co. is one of the largest in Kentucky.

The surface rocks of Carter County consist principally of sandstones, sandstone conglomerates, shales and coals of the Pottsville (Lower Pennsylvanian) System under which occur and come to outcrop on Tygarts Creek and Big and Little Sinking creeks excellent fireclays resting above limestones of upper Mississippian age. Glacial deposits in the form of very occasional igneous and metamorphic pebbles occur in this region. The normal structure of the county is inclined to the southeast, but this is interrupted by a number of local plunging and doming anticlines. There are no faults of consequence in Carter County.

The mineral resources of Carter County consist of coals, flint fireclays, limestones, sands, gravels, clays and mineral waters. During the year 1925 a total of 72,625 tons of coal were

produced chiefly in the eastern part of the county along the waters of Little Sandy. In western Carter County highgrade flint fireclays are produced within the region of outcrop on the waters of Tygarts Creek of the Upper Mississippian limestones. Plastic clays (Pottsville) are produced in the eastern part of Carter County and weathered residual clay-shales are available for brick manufacture. Sands occur in residual (Pennsylvanian) and transported (Recent and Pleistocene) deposits at various depths in this district suitable for general construction,

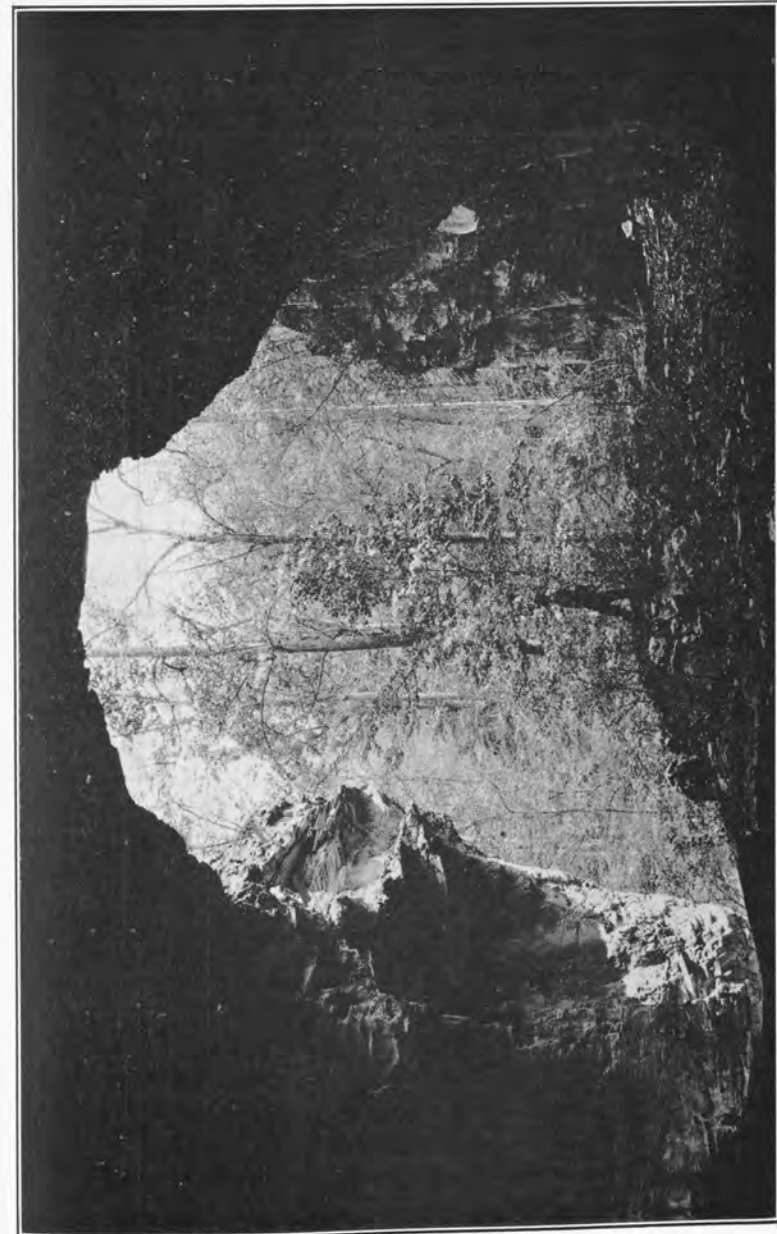


A FIRE BRICK OPERATION AT GRAHN.

Carter County is well and widely known for its excellent flint fire clays which occur at the base of the Coal Measures.

glass making and metal molding purposes. Limestones suitable for general building purposes, highway and railway bed construction, and for iron fluxing occur on the waters of Tygarts Creek. One of the beds exposed, the Gasper (Mississippian) oolitic limestone, might be used for agricultural lime since it is high in calcium carbonate.

Oil and gas have both been secured in small, yet commercial quantities in Carter County. An interesting natural gas field has been developed in the eastern part of the county in the vicinity of Denton, while oil occurs principally in the western part of the county in what is known as the "Smoky" country, the "Wier," "Berea" (Mississippian), and "Corniferous" (Devonian) sands producing. Mineral waters are known to occur in



ONE OF THE WELL KNOWN CARTER CAVES.

These caverns were produced in Upper Mississippian lime stones by underground streams much in the same manner as were the countless caverns of the Mammoth Cave region. Good roads here have made it possible for thousands of tourists to visit these caves annually.

Carter County but are not now utilized. One of the most important but slightly utilized natural resources of Carter County is its scenery consisting of a wealth of wild and slightly inhabited "gorge and hill" country coupled with many caves and some



BONE LICK FIRE CLAY MINE.

Carter County has many such mines capped by the Pottsville Conglomerate sandstone and generally underlain by limestones of Upper Mississippian (Chester) age.

rather notable natural bridges in limestone, one of which located a few miles northwest of Olive Hill is traversed by the old country road of the region.

A geological oil and gas structural map of Carter County produced in 1925 is available, scaled one inch to the mile. The eastern part of the county has been mapped topographically,

scale 1:125,000, on the Kenova Quadrangle. A small area in the southwestern part of the quadrangle is shown on the new Morehead Sheet, scaled 1:62,500.

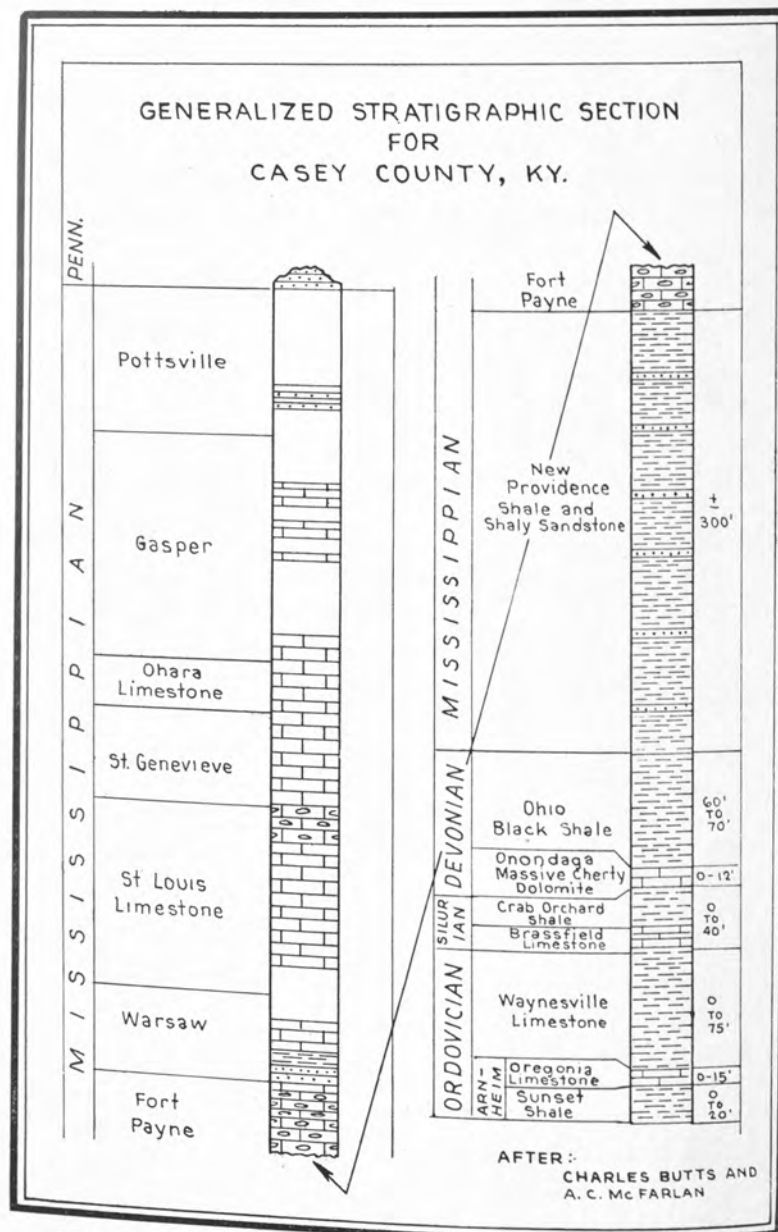
XXIII.

CASEY COUNTY

Casey County is located in central Kentucky in the northeastern part of the Pennyroyal immediately south of the Knobs Belt. It covers an area of about 379 square miles. Drained only by headwaters streams of the Green River, the South Fork of Salt River, and Fishing Creek of Cumberland River, it is extremely hilly—an excellent example of a maturely dissected plateau. Liberty, the county seat, located in the bottoms of Green River has an elevation of 800 feet above sea level, while surrounding ridge lands rise 300-400 feet higher. In the southern tip of the county Green River Knob a few miles southwest of Mintonville has an elevation of about 1785.5 feet.

The rocks exposed in Casey County exhibit a long sequence of Paleozoic sediments. In the northern part of the county Upper Ordovician limestones are exposed in the headwaters branches of Salt and Green rivers. Succeeding these formations to the southeast, south and southwest, and in rising sequence Silurian limestones, Devonian limestones and shales, and Lower Mississippian calcareous sandstones and limestones appear. Ridges in the eastern part of the county are capped with St. Louis and adjacent limestones (Meramec-Mississippian), while the Green River Knob near the Pulaski County line is an outlier of the Eastern Kentucky Coal Field. Beneath the Pottsville (Pennsylvanian) sandstone capping this knob are some beds of Chester age. The normal structure of the county as might be interpreted from its position on the crest of the Cincinnati Arch and immediately south of the Lexington Dome, is southerly along the main waters of Green River. The strata in the eastern and western tips of the county dip respectively at very low angles to the southeast and west. Two minor intercepting faults striking north out of Russell County occur on the waters of Goose Creek and have developed slightly south of Dunnville a small graben surfaced with Maramec sediments.

The mineral resources of Casey County consist of limestones suitable for rural building, highway and railway bed construc-



GENERAL STRATIGRAPHIC SECTION FOR CASEY COUNTY,
KENTUCKY.

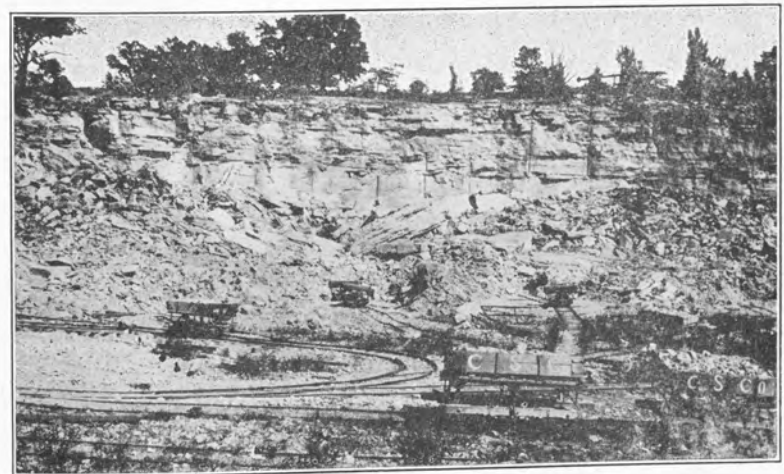
tion purposes. Gravels occur in abundance and are used somewhat for road making. Small amounts of oil and gas have been secured in a number of wells, the producing sands being the Corniferous (Devonian) and strays in the Upper Ordovician. A considerable outcrop of the Devonian shale occurring in this county assures a large source at some future time for the manufacture of artificial petroleum.

An oil and gas map of Casey County scaled one inch equals one mile is available. No detailed topography has been executed for this region.

XXIV.

CHRISTIAN COUNTY

Christian County containing about 725 square miles and therefore one of the really large counties of this State, is located in western Kentucky adjoining the Tennessee line. It is a part of the western Pennyroyal and is drained by the headwaters tributaries of the Pond, Tradewater and Cumberland rivers.



LIMESTONE QUARRY AT HOPKINSVILLE.

Christian County has many excellent beds of Mississippian limestone broadly distributed and well located with respect to transportation.

Physiographically, Christian County is a semi-maturely dissected limestone upland. Hopkinsville on the waters of the North Fork of Little River has an elevation of 525 feet, but ridge elevations on the headwaters of Mud River in the vicinity of Crofton rise to about 800 feet in numerous instances. A number of isolated knobs exist in the northern part of the county, and some of these such as "Pilot Knob" are well and widely known.

The rocks of Christian County consist of limestones, sandstones, sandstone conglomerates, shales and coals. The northern part of the county is overlapped by the Lower (Pottsville-Pennsylvanian) Coal Measures; and in this district several coals

are known to occur. South of the Pennsylvanian outcrop, Chester limestones, sandstones and shales cover a broad belt as far south as Hopkinsville, the southern part of the county being surfaced by limestones and shaly limestones of the Meramec (Lower Mississippian System). Alluviums of Recent and Pleistocene age occur on the upper waters of Pond River. The normal regional structure of Christian County is an extensive monocline, strata in the northern part of the county dipping rapidly to the north, while those in the southern part of the county have the same direction of general inclination but at a much lower angle. Christian County exhibits much normal faulting, principally in the northern half in the area of Chester and Pottsville outcrop. The pattern of these faults falls into two orders of strike: (1) generally east and west, and (2) northwest and southeast. The resulting structure for areas in the vicinity of Era and Crofton is very complex.

The most important mineral resources of Christian County are bituminous coal and limestone. In 1925 a total of 92,720 tons of coal were produced in this county. Limestones suitable for all general purposes of building, highway, and railway bed construction are available and broadly distributed. Good agricultural limestones are also present. Sands suitable for constructional purposes occur in many of the north flowing streams as transported deposits, and in the northern uplands as occasional residual deposits. Oil and gas has been found in small quantities at widely separated points throughout the district. Bituminous sandstones (Pottsville) of unproven value as rock asphalt occur in northern Christian County.

A reconnaissance geological map of Christian County (combined with Trigg) is available, scale one inch equals two miles. A new oil and gas and regional geological map of Christian County is available in colors to the scale of one inch equals one mile. Detailed structural quadrangular maps centering about Era and Crofton have been completed. The topography of the northern part of the county has been executed, scale 1:62,500 on the Dawson Springs and Nortonville quadrangles.

XXV.

CLARK COUNTY

Clark County is situated in central Kentucky high on the eastern limb of the Lexington Dome of the Cincinnati Arch. It contains 266.4 square miles. The terrain gently undulating in the northwest and deeply dissected in the southeast is typical respectively of both the Inner and Outer Bluegrass Regions. It is drained by local minor tributaries of the Kentucky River, the Red River, and the headwaters of the South Fork of the Licking



A CLARK COUNTY HEMP FIELD.

Excellent residual limestone soils produced from beds of Ordovician age give the Bluegrass region its agricultural distinction.

River. Winchester, the county seat, situated on the divide between these two streams has an elevation of 981 feet, and is surpassed only by some remote upland elevations to the northwest in the vicinity of the Fayette County line.

The hard rocks of Clark County consist principally of limestones, shaly limestones and shales of the Upper Ordovician series, but beds representative of the Champlainian (Lower Ordovician) occur on Boone Creek, Lower Howard Creek, and in the Kentucky River gorge somewhat below Ford. The southeastern part of the county exhibits considerable areas of limestone of Silurian age, while Devonian limestones and shales (the

Chattanooga) are found on the waters of Upper Howard and Lubegrud creeks and the Red River. The normal regional structure of Clark County is a monoclinical platform tilted to the southeast, as the position of the county on the eastern flank of the Lexington Dome readily indicates. The county is bisected, however, by the Kentucky River faults which pass through Elkin and the region immediately southeast is offset with a northeast strike towards Montgomery County.

The mineral resources of Clark County consist principally of limestones which occur here in quality and quantity adequate for rural building, abutment, highway and railway bed construction. Sands suitable for general constructional purposes may be dredged from the beds of both the Kentucky and Red rivers. Chattanooga (Devonian) oil shales in large outcrop in the eastern part of the county insure a possible source of a very considerable amount of artificial petroleum at some future time if necessary.

A geographic map of Clark County, published in 1926, scale one inch equals one mile, is available. This map shows the course of the Boonesboro and the Dry Fork Fault zones. The topography of the southern part of the county has been presented, scale 1:125,000, on the Richmond and Beattyville quadrangles. A small area in the northwestern part of Clark County is shown on the new Lexington Quadrangle, scale 1:62,500.

XXVI.

CLAY COUNTY

Clay County is situated in the southern central part of the Eastern Kentucky Coal Field. Covering an area of 531.01 square miles, it has typical "Mountain" topography. The region is one of mature dissection with narrow winding ridges and V-shaped valleys of meandering figure. Nearly all of the county is drained by the South Fork of the Kentucky River through three principal headwaters tributaries: (1) Red Bird, (2) Goose



BURNING SPRINGS IN CLAY COUNTY.

This little hamlet nestles among hills of low figure carved out of Pottsville sandstones and shales. Old seepages of natural gas gave the place its name. The topography is characteristic of the northern part of Clay County.

Creek, and (3) Sextons Creek. A small part of the drainage of this county goes to the Cumberland River through the northwest flowing headwaters of the South Fork of the Rockcastle River. Manchester, the county seat with an elevation of 860 feet is surrounded by a maze of timbered ridges which in the southeastern part of this district attain a maximum elevation of about 2200 feet.

The rocks exposed in Clay County consist of sandstones, sandstone conglomerates, shales and coals of the Pottsville (Pennsylvanian) formation. The normal structure of the county is inclined to the southeast where the Eastern Kentucky Geosyncline traverses northeastwardly the headwaters of Goose and

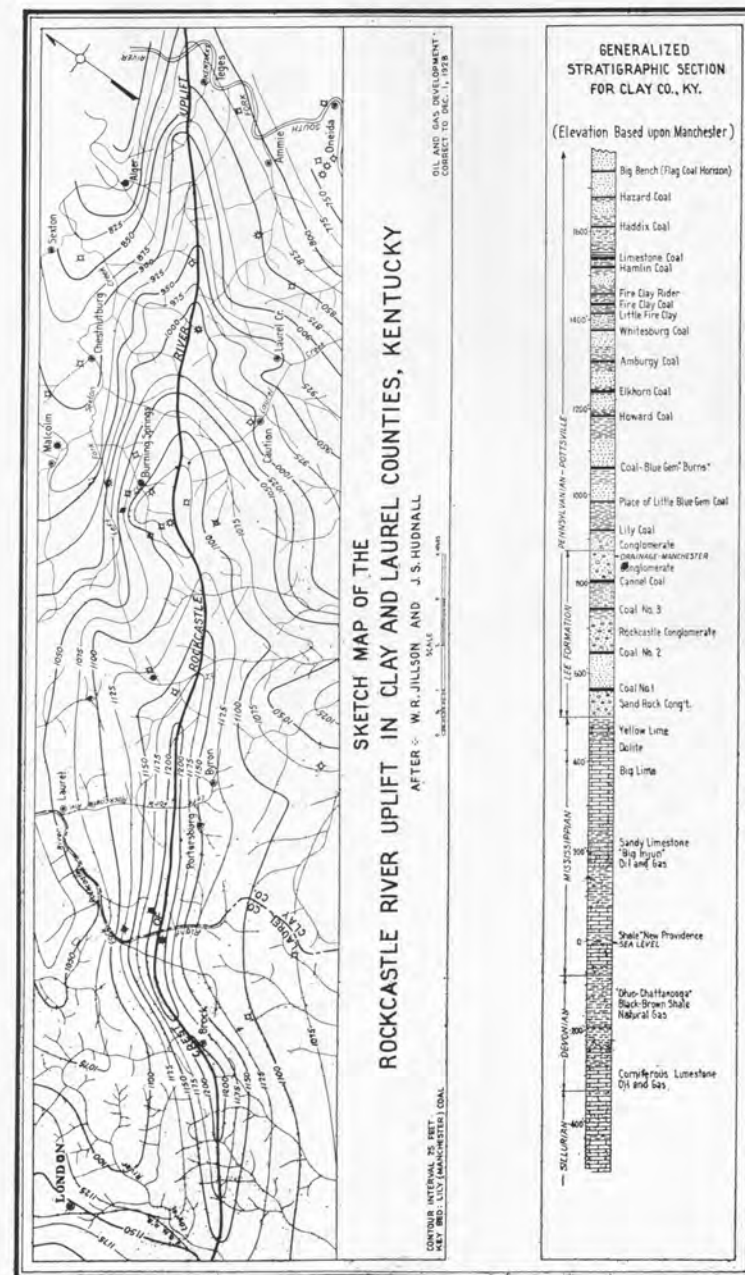
Red Bird creeks. A small tip southeast of this major syncline exhibits surface dips to the northwest. The northern part of the county is traversed by the Rockcastle River Uplift, a major anticlinal feature; while the central portion of the county is flecked by numerous anticlines and synclines. There are no faults of major consequence in Clay County.

Bituminous coal is the principal mineral resource of Clay County. During the year 1925, 81,690 tons of coal were pro-



TILTED SANDSTONES ON BURNING SPRINGS DOME.
These beds of Pottsville age on Sexton creek in northern Clay County dip at an angle of 5 degrees north 145 degrees east.

duced and exported. One of the greatest but at the present time very slightly developed resources of Clay County is natural gas, this mineral being prominently identified with the Rockcastle River Uplift and other minor anticline features in the vicinity of Oneida and elsewhere. Oil in some quantities has also been produced in Clay County, the production of each of these resources coming principally from the "Corniferous" (Devonian), "Big Lime" and "Big Injun" (Mississippian) limestones and calcareous sandstones at medium depths. Clay County also contains sands suitable for general construction purposes and some rather coarse gravels, these being transported, or fluvatile deposits found in stream bed or in flood plain position. Residual clays and some transported clays in this county might be used for ordinary brick making. Saline and similar mineral waters have been produced from the earliest times of white settlement in the vicinity of Manchester from natural brines secured by drilled



wells from Coal Measure sandstones at shallow depths. Within recent years these excellent mineral waters have been abandoned.

A recently produced oil and gas structural map of Clay County showing structural and stratigraphic sections, scaled one inch equals one mile, is available. The region has been mapped topographically, scale one inch equals two miles, on the Manchester and Cumberland Gap quadrangles.

XXVII.

CLINTON COUNTY

Clinton County is located in southern Kentucky adjoining the Tennessee line on the eastern border of the Pennyroyal. A small and rather compact unit, it covers only 235 square miles. It is drained by Indian and Otter creeks, north flowing tribu-

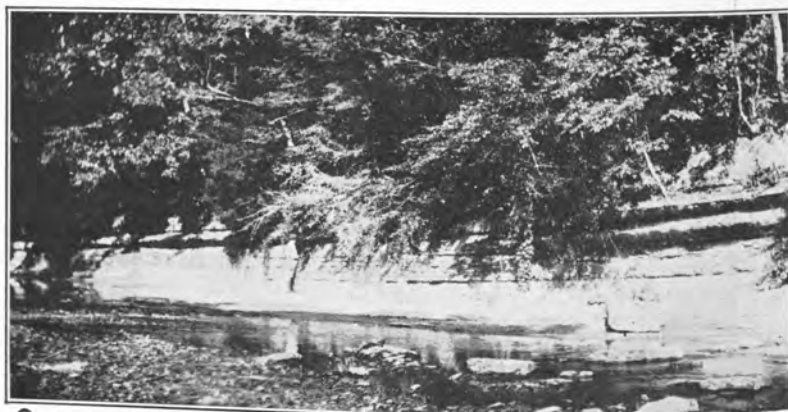


PICTURESQUE "FALLS OF 76."

This waterfall produced by erosion resisting calcareous beds of the Lower Mississippian has wide and well deserved reputation for natural beauty. Its name is in no way connected with American history but is derived from its height according to local tradition.

taries of Cumberland River, and Spring and Illwill creeks of Wolfe River flowing southward into the Tennessee. The region presents parts of two maturely dissected plateaux. Remnants of the higher, older upland are to be seen in Poplar Mountain which attain an elevation of 1745 feet. Albany, the county seat, has an elevation of 961 feet above sea level, and is a part of the lower plateau which is about 1000 feet high.

The hard rocks of Clinton County are composed of limestones, sandstones and shales of the Upper Ordovician, Devonian, and Mississippian systems. The rocks of the latter named series constitute the major upland area of the county. Sandstones, sandstone conglomerates and coals of Pottsville (Lower Pennsylvanian) age extend into the eastern part of the county in Poplar Mountain, Sewell Mountain and adjacent knobs as ridge capping formations. The regional structure of Clinton County is a monocline dipping to the southeast, the county being located on the southeast flank of the Cincinnati Arch. While



CLIFTED LIMESTONE ON WOLFE RIVER.

The view is near the Tennessee line and shows close to drainage levels limestone of Lower Osage (Mississippian) age.

minor folding in the form of anticlines and synclines of local significance only are known to occur throughout this county, faulting of marked degree is unknown.

The mineral resources of Clinton County consist principally of limestones suitable for general building, highway and railroad bed construction. Certain grades might be used with success as agricultural limes. Both oil and gas have been produced from important "sands" in small quantities, and coal is mined in the eastern part of the county for local consumption. Loose sands suitable for general constructional purposes occur in the bottoms of Cumberland River, and clays of alluvial nature in the Cumberland River bottoms as well as residual upland clays might be used for brick making purposes. A small outcrop of the Chat-

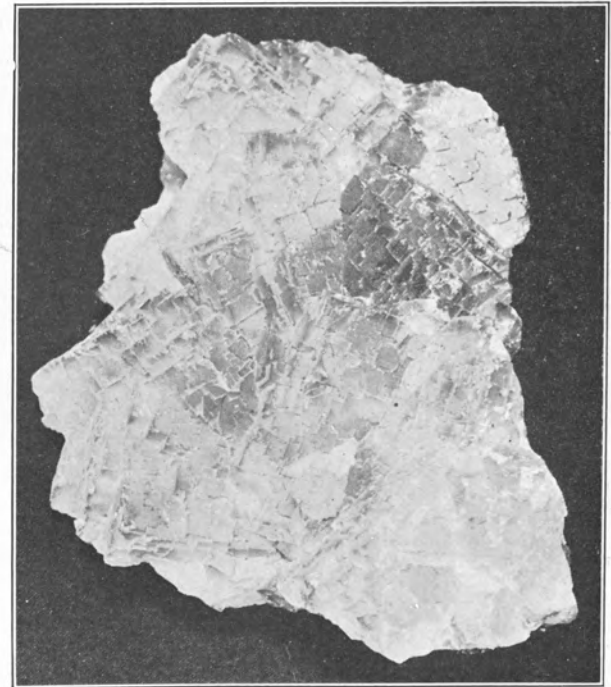
tanooga (Devonian) shale in the northern part of the county, and on Indian Creek and Illwill Creek in the southwestern part of the county assures future resources for the manufacturing of artificial petroleum if necessary.

A geographic map of Clinton County, scale one inch equals one mile, published in 1925, is available. New topography for the southern part of this district has been prepared, scaled 1:62,500, and is presented on the Byrdstown, Lillydale and Sunnybrook quadrangles.

XXVIII.

CRITTENDEN COUNTY

Crittenden County is located in the western extremity of the Pennyroyal district in Kentucky adjoining the Ohio River and the State of Illinois. It exhibits an area of 391 square



CRITTENDEN COUNTY FLUORITE.

This specimen amethystine in color and eighteen inches across was taken from the Holly mine. It is of first quality.

miles. It is drained by local tributaries of the Tradewater, Ohio and Cumberland rivers. The region is a maturely dissected plateau in which much of the physiography has been influenced by block faulting. Marion, the county seat, has an elevation of 595 feet above which ridge lands rise to 700 and occasionally to 800 feet. The minimum elevation of the county—

330 feet—is found at low water on the Ohio at the mouth of Deer Creek.

The hard rocks exposed in Crittenden County consist of limestones, sandstones and shales of Mississippian age upon which are superimposed in the northeastern part of the county sandstones, sandstone conglomerates, shales and coals of Pottsville (Lower Pennsylvanian) age. The county is traversed by a belt of mica peridotite (igneous) dikes which strike north 45 degrees west across the Ohio River into Illinois. A score or more of these dark basic intrusions have been mapped on the Cave-in-



FLUORSPAR MINE NEAR MARION, KY.
The heart of the fluorite (CaF_2) industry in North America is in this part of Western Kentucky.

Rock Quadrangle. These intrusions occasionally occurring as "sills" involve the Mississippian rocks and are believed to be post-Paleozoic age, but may be of later formation. Isolated deposits of upland cherty gravels such as those near Hurricane Church on Caney Fork have been referred to the Lower Cretaceous. Alluviums of Recent and Pleistocene age occur along the Ohio River lowlands and some of the major tributary streams of the Tradewater and Cumberland rivers. A fine, silt-like, sub-aerial glacial deposit known as loess of Pleistocene age is found not infrequently in both lowlands and some upland localities in the northwestern part of Crittenden County.

The normal structure of the greater part of Crittenden County is inclined to the northeast since the district is one that is superimposed upon the eastern flank of the Kuttawa Arch of western Kentucky. The local structure may and frequently does differ markedly from the normal trends of inclination due to the fact that all of Crittenden County is very complexly faulted, principally along a northeast and southwest line of strike. One hundred and twenty-five separate faults have been mapped and described for the area involved in the Cave-in-



TOPOGRAPHY OF SOUTHERN CRITTENDEN COUNTY.
Fault blocks exhibiting variable displacement and surface lithology account for the remarkably irregular surface features of this part of the "Pennyroyal."

Rock Quadrangle alone. These normal or tension faults exhibit various displacements in some instances, as in the case of the great Commodore Fault attaining 1500 to 2000 feet.

The mineral resource of chief importance in Crittenden County is fluorspar, known technically as fluorite, CaF_2 . It is glassy in appearance and variously colored from purple to green, brown, yellow, and white. It occurs in bodies of commercial size as vein deposits in fissures formed by regional faulting. Associated with the fluorspar are found vein deposits of calcite and the metallic minerals: galena (lead), sphalerite (zinc), and smithsonite (zinc). In 1926 Crittenden County was the chief producer of fluorspar in Kentucky. During the same period Kentucky led the United States and the world in the produc-

tion of 62,495 tons of flourspar, valued at \$1,167,128. The bulk of this production was secured from mines shortly to the west and in the vicinity of Mexico, Crayne, and Marion. Lead and zinc are produced only as by-products of flourspar. Other vein minerals of very secondary importance are: barite, quartz, greenockite, pyrite, chalcopyrite, and cerusite.

The fluorite specimens shown in natural tints in the frontispiece of this volume were selected from the large and excellent collection of Col. Avery H. Reed of Marion, Kentucky. Much credit is due Mr. Reed for his fine cooperative spirit in making these crystals available for colored reproduction in this public document.

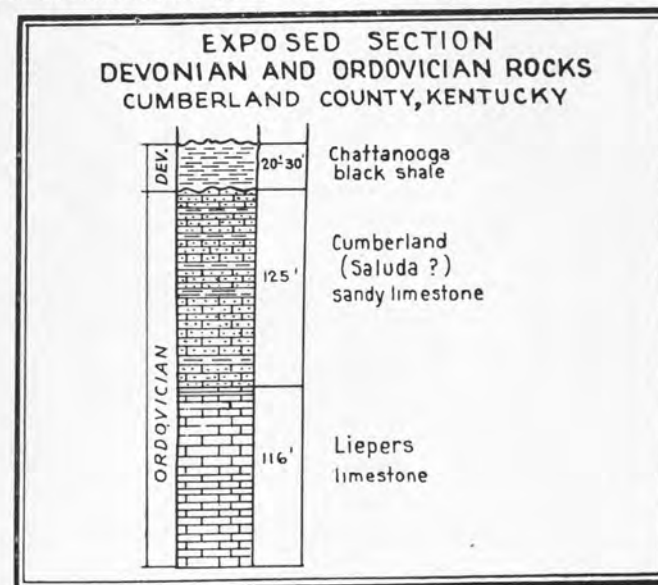
Coal occurs in the eastern part of this county, but its mining is of relative insignificance. Limestones suitable for general building, highway and general railway bed construction are available in unlimited quantities. Some deposits of Gasper (Chester-Mississippian) and other oolitic limestones might well be used for agricultural and chemical lime, as these beds are frequently very high in calcium carbonate. Sands suitable for glass-making occur as residual deposits (Mississippian), soft and friable or entirely decomposed, in the uplands in the vicinity of Marion, while alluvial sands occur in the river beds and might be used for general construction purposes. Gravels in unlimited quantities are available from the Ohio River for road-making, building, and concrete construction. Oil and gas in insignificant quantities have been found in a few exploratory drillings at shallow depths, but commercial quantities of oil are not anticipated for this region.

Crittenden County has been mapped and reported upon geologically on the Golconda and Cave-in-Rock quadrangles. A geographic and mining operators' map of the county, issued a few years ago, scale 1 inch equals 1 mile, is now exhausted in edition. Surveys have recently been completed for the presentation of a new geological and mineral map of the county which will be presented in colors early in 1929. The topography of this county has been recently presented on the Golconda, Cave-in-Rock, Eddyville and Providence quadrangles, scale 1:62,500.

XXIX.

CUMBERLAND COUNTY.

Cumberland County, well within the Pennyroyal, is situated in southern Kentucky adjoining the Tennessee line. Areally it covers about 387 square miles. It is a maturely dissected plateau with bottoms about three-fourths of a mile in width following



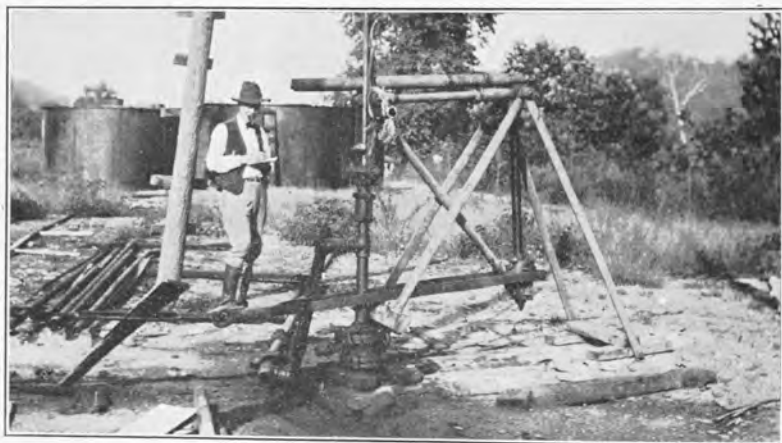
After P. H. Dunn

EXPOSED SECTION DEVONIAN AND ORDOVICIAN ROCKS
CUMBERLAND COUNTY, KENTUCKY.

the meanders of the stream of master drainage—the Cumberland River—which bisects the county, flowing to the southwest into the State of Tennessee. Burkesville, the county seat, situated on an old river terrace, has an elevation of 581 feet above sea level, but ridge tops, particularly in the southern and eastern parts of the county, attain elevations ranging from 900-1,050 feet. The minimum elevation is 547 feet, at Black's Ferry near the Monroe County line.

The hard rocks of Cumberland County consist of Paleozoic limestones, sandstones and shales, beginning with the Upper

Ordovician formations and extending upwards through the Devonian and well into the Upper Mississippian. Situated on the crest of the Cincinnati Arch, which passes through the western part of Cumberland County, the normal structure of this region is anticlinal or saddle-like. East of the Cumberland River the rocks have a general trend to the southeast, whereas those on the headwaters of Marrowbone and Renox creeks dip to the northwest. These general or regional dips are, however, modified at many points by local flexings of pronounced degree, de-



IN THE KETTLE CREEK OIL POOL.

This producing area is partly in Cumberland and partly in Monroe County. The Bud Kerr No. 1 well, a large flush producer, is shown here.

veloping rather conspicuous minor anticlines and synclines, and other associated features. No faults of consequence are known to occur in Cumberland County.

The chief mineral resource of Cumberland County is petroleum, which, with the relatively small amounts of natural gas, is secured from the Corniferous (Devonian), Sunnybrook, and Trenton (Ordovician) sands. In 1925, 69,805 barrels of oil, valued at \$162,451, were produced in Cumberland County. The greater part of this oil was transported by the Paragon Pipe Line Company from Burkesville to Glasgow in Barren County. Limestones suitable for general rural building, highway and railway bed construction are available at numerous points throughout the county. In the eastern part of this district some

rather pure limestones of Upper Mississippian age occur in the ridge tops. These rocks might be used for agricultural purposes. Transported sands along the Cumberland River are available for purposes of general construction, and gravels suitable for road materials are found in many of the creek beds. The Devonian shale outcropping throughout the course of the Cumberland River is available, if needed as a future supply of artificial petroleum.



OLD AMERICAN OIL WELL.

This was the first drilled well to produce oil in Cumberland County. It was completed a hundred years ago—1829—on Little Renox creek.

An oil and gas map of Cumberland County is available, and the structure of the southern part of the county, involving the principal oil producing districts, is also available in connection with parts of Monroe and Clinton counties. The topography of the southern part of Cumberland County has been delineated to the scale of 1:62,500 on the Lillydale and Byrdstown quadrangles.

XXX.

DAVIESS COUNTY.

Daviess County is located in the northern part of the Western Kentucky Coal Field adjoining the Ohio River on the north and the State of Indiana. As a unit area it covers 499.88 square miles. It is a region of mature dissection and widespread depositional alluviation, resulting in a central northern alluvial plain along the waters of the Ohio River, Green River, Panther and



THE PANTHER CREEK DITCH.

Valley filling has been so extensive as to require much ditching in many parts of Daviess County.

Blackford creeks. Hills, existing either as insular Pennsylvanian outliers in this broad alluviated plain near the Ohio River, or as low winding ridges, form the southern and eastern boundaries of the county. Owensboro, the county seat, on the Ohio River flood plain, with an elevation of 395 feet, is somewhat below the upland relief of this county, which frequently attains elevations ranging from 600 to 650 feet.

The hard rocks of Daviess County consist of sandstones, shales and coals of Pottsville and Allegheny (Pennsylvanian) age. Alluvial deposits of fluvatile and lacustrine origin, filling the broad bottoms of the Ohio and Green rivers as well as Panther and Blackford creeks, are of Pleistocene and Recent age. The regional structure of the county is of westward inclination, though this general statement finds exception in the occurrence

of a number of rather poorly defined anticlines and synclines. Daviess County is located just to the north of the important Rough Creek Fault and Fold, and is bounded on the west by the Curdsville Fault, which follows somewhat generally the northeastward course of the Green River to within a short distance of Birk. Other normal faults, covered by alluvium, possibly occur in this county.

The principal mineral resource of Daviess County is coal, this district having produced in 1925, 156,454 tons. Petroleum in increasing quantities and some small amounts of natural gas have been produced from shallow Chester (Upper Mississippian) "sands" in Daviess County, mainly in the eastern and southern parts adjoining the Ohio and McLean lines in the vicinity of Whitesville and Utica. Alluvial sands suitable for general construction purposes are found in isolated deposits in this section, and gravels suitable and widely used for road-building materials occur in inexhaustible quantity in the Ohio River.

A new geological map of Daviess County, scale 1 inch equals 1 mile, showing oil and gas structural features and stratigraphic section is available. The topography of this district has been executed to the scale of 1:62,500 and is presented on the Newberg, Owensboro, Tell City, Whitesville, Sutherland and Calhoun quadrangles.

XXXI.

EDMONSON COUNTY.

Edmonson County is located in southern central Kentucky, partly in the Western Coal Field and partly in the Pennyroyal district. It contains 340 square miles. The county is bisected by Green River. The Nolin River and Bear Creek, flowing southwardly, are the largest local tributaries of the Green River. Beaver Dam, a somewhat smaller stream flowing to the northwest, joins Green River below Brownsville. The terrain of Edmonson County is hilly throughout. Along portions of the Green



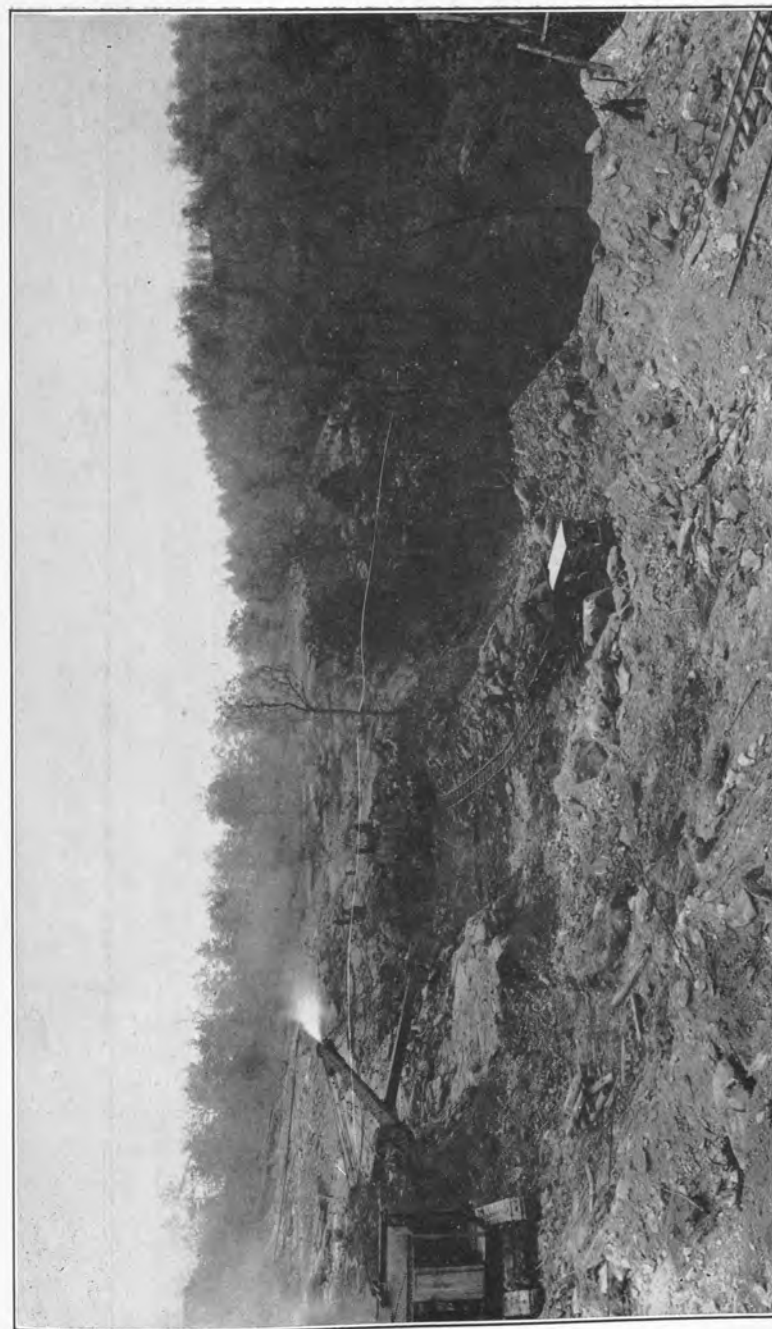
ENTRANCE TO MAMMOTH CAVE.

and Nolin rivers, as well as the lower portion of Bear Creek, the topography is precipitous. Brownsville, the county seat, has an elevation of 537 feet, but ridge elevations to the southeast rise 250 to 300 feet higher. The minimum elevation of 405 feet is found on the Green River at the mouth of Bear Creek.

The hard rocks of Edmonson County consist of Chester (Mississippian) limestones, sandstones, and shales in the southeastern half and Pottsville (Pennsylvanian) sandstones, sandstone conglomerates, shales, and coals in the northern half, except in restricted areas in the river bottoms of this region where Upper Mississippian formations are present. The structure of Edmonson County is geo-synclinal, the great trough of



A CAVERN CHAMBER IN EDMONSON.
This, the well known Frozen Niagara, is typical of many of the fine caves in the Mammoth Cave district, soon to be a National Park.

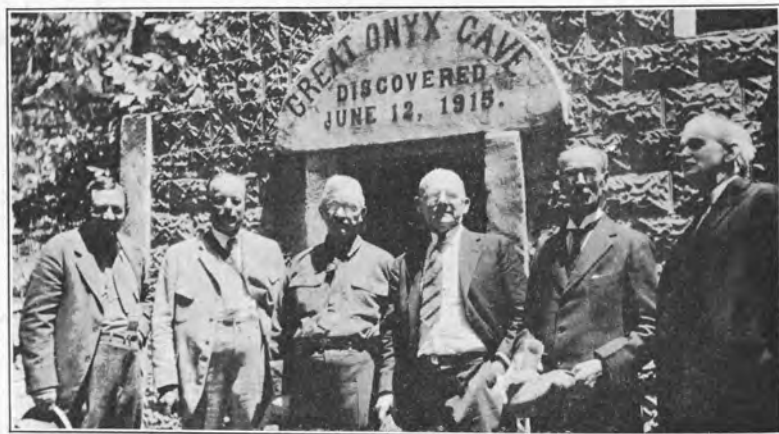


ROCK ASPHALT QUARRY ON GULF HOLLOW.

All of the presently operated asphalt quarries in Edmonson County are of the "open cut" type. Soil and low grade rock are stripped and dropped by gravity over adjoining cliffs, thus entailing relatively low costs.

the Western Kentucky Coal Field striking westwardly through this county. A few flexures of low angle are visible at various points, and several normal or tension faults with displacements ranging from 25 to 75 feet such as the one crossing lower Honey Creek, strike northeastwardly through the southern part of the county. One normal fault with northwestern strike is found in the northeastern quadrant between Green River and Nolin River.

The principal mineral resource of Edmonson County is bituminous sandstone, widely known and used under the trade



THE SOUTHERN APPALACHIAN NATIONAL PARK COMMISSION.

This body visited and approved the Mammoth Cave region for a new National Park in the spring of 1925. Reading from left to right are Maj. W. A. Welch, Harlan P. Kelsey, Hon. H. W. Temple, Col. Glenn S. Smith, W. C. Gregg and the late Dr. Willis T. Lee. The writer accompanied them as the personal representative of the Governor during the inspection.

name of rock asphalt. This county has some of the largest and best deposits in the entire state of Kentucky. The largest operations of rock asphalt in Kentucky—at the present time three in number—are found in Edmonson County. In addition to this valuable resource, there are four coal seams, two of which are of local or domestic importance. Limestones in southeastern Edmonson County are suitable for building, highway and railway-bed construction. Residual sand deposits of a limited extent are used for general construction purposes.

A geological and rock asphalt map of Edmonson County, published in 1926 to the scale of 1:62,500, is available. An excellent and detailed report on the geology of Edmonson County

was published by the Kentucky Geological Survey in 1927 and is now in course of distribution. During the passing year of 1928 a special guide to the geology and physiography of the Mammoth Cave Park area has also been issued and is now in excellent demand. The topography has been recently executed and may be had on the Brownsville, Mammoth Cave, Leitchfield, and Cub Run quadrangles, scale 1:62,500 or approximately 1 inch to the mile.

XXXII.

ELLIOTT COUNTY.

Elliott County is located in the northeastern Kentucky coal field and is properly described as a part of the "mountains," though it exhibits no great relief. Areally it covers 247.11 square miles. Physiographically, it is a part of the maturely dissected Allegheny plateau. It exhibits many winding ridges and narrow meandering stream bottoms. There are but small amounts



VALLEY OF THE OPEN FORK OF LITTLE SANDY RIVER.

This view is just south of the great fault. Surface rocks are all of Lower Pottsville age.

of flat or undulating land, either in the bottoms or uplands. Sandy Hook, the county seat, has an elevation of 785 feet, but ridge lands surrounding to the southeast attain elevations ranging up to 1,100 and 1,500 feet. The region is drained by the headwaters tributaries of Little Sandy River northeastward to the Ohio.

The hard rocks of Elliott County consist for the most part of sandstones, sandstone conglomerates, shales, and coals, including some cannel coals of the Pottsville (Lower Pennsylvanian) series. Occasional hilltops in southeastern and eastern Elliott County are capped with disintegrating remnants or outliers of the Allegheny (Lower Pennsylvanian) group of clastics.

In the eastward flowing headwaters of Laurel, Caney, Little Caney, Gimlet, and Big Sinking creeks, Chester (Mississippian) limestones, shales, and fireclays are exposed. Elliott County exhibits on the headwaters of Little Fork of Sandy about 9 miles due east of Newfoundland a group of dark mica peridotite (igneous) dikes, the only rocks of this classification known to exist in Eastern Kentucky. Though pierced by this fluid magma, the surrounding Coal Measure sandstone and shale appear to be but very slightly metamorphosed. Included fragments of lower beds, however, particularly the Ohio (Devonian) black shale,



NORTH FLANK SANDY HOOK ANTICLINE.

Strong beds of Pottsville sandstone dip pronouncedly to the northeast, while the axis of this structure, first described by the writer in 1921, plunges to the east.

exhibit advanced alteration. The normal regional structure of Elliott County is inclined to the southeast, but the central part of the county is bisected by the Little Sandy Fault. This pronounced structural feature strikes somewhat slightly north of east and is located between Sandy Hook and Newfoundland. It exhibits a varying displacement ranging from a few up to about 200 feet, and may be seen crossing the lower waters of Newcombe Creek, Middle and Open Forks of the Little Sandy. This fault is paralleled by the Sandy Hook Anticline, a flexure of pronounced degree which on the divide between Little Fork and Newcombe Creek is intersected by the transverse north and south extension of the Paint Creek Uplift.

The mineral resources of Elliott County consist principally of petroleum, natural gas and coal. Commercial deposits of oil have been produced on the headwaters of Newcombe Creek and from the Wier and Berea (Mississippian) "sands." Natural gas has also been produced in this locality from these Mississippian "sands," and the underlying Corniferous (Devonian) limestones. Coals of both bituminous and cannel grades are available in large amounts in southeastern Elliott County, but since this district is not traversed by a railroad, these bituminous deposits are operated for local domestic consumption only. Sands suitable for general construction purposes are available as alluvial and residual deposits throughout the county. Limestones for general building, highway and railroad bed construction may be secured in the northeastern part of the county.

An oil and gas map of Elliott County, scale 1 inch equals 1 mile, is available, as is also a similarly scaled contoured structural geological map, published during 1928. The district has been topographically surveyed along its eastern boundary, at the scale 1:125,000, on the Kenova Quadrangle. The western part of the county is shown on the new Morehead Quadrangle, scale 1:62,500. Field surveys of the topography of the Sandy Hook Quadrangle to the same scale as the new Morehead Sheet are now in progress and will be completed during the season of 1929.

XXXIII.

ESTILL COUNTY.

Estill County is located in the Knobs Belt on the border of the Eastern Kentucky Coal Field in central eastern Kentucky. It covers 254 square miles. This district physiographically is a maturely dissected plateau with no flat lands except in the western part between Drowning Creek and the Kentucky River. Irvine, the county seat, located on an old terrace of the Ken-



ST. LOUIS LIMESTONE ON BEATTYVILLE ROAD.

On the road from Irvine up Cow Creek there are many excellent new exposures of the Mississippian. Oriole and Willard Jillson, Jr., are at the right.

tucky, with an elevation of 625 feet, is surpassed by many of the adjacent knobs as well as the ridges to the southeast which rise to elevations of 1,300 and 1,400 feet.

The hard rocks of this county consist of limestones, sandstones, and shales, beginning with the Upper Ordovician formation along the Kentucky River near the Madison County line and extending upward stratigraphically through the Silurian, Devonian, and Mississippian, and into the base (Pottsville) of the Pennsylvanian System. The normal structure of the county on a regional basis is inclined to the southeast, but locally this platform is distorted by a number of local anticlines. The pronounced Irvine-Paint Creek Fault Zone, consisting of two paral-

lel faults, traverses the entire western part of Estill County along a flexed line of strike which is in pattern a combination of two reversed arcs. This zone of deformation extends from Madison County on the southwest to Powell County on the northeast. The displacement of these faults for the most part is slight, particularly in the west near Panola, where it is about 30 or 40 feet. At some points farther east it shows a greater throw. Three miles southwest of Irvine it is 57 feet, at Estill Springs it is about 72 feet, and near Union Hall it is 90 feet in stratigraphic offset.



KNOB TOPOGRAPHY AT RAVENNA.

The Devonian black shale occurs near drainage while the Mississippian reaches to the hill tops.

The principal mineral resource of Estill County is petroleum, which has been secured in a number of localized pools. These begin at Ravenna and extend northeastward to the Lee County line north of the Kentucky River, and south of this stream occur on the waters of Station Camp Creek. Production, accompanied by some natural gas, is secured from the Corniferous (Devonian) limestones at shallow to medium depths. During the calendar year 1925, Estill County produced 436,482 barrels of oil, valued at \$1,001,120. Petroleum amounting to 4,393,141 barrels, valued at \$11,047,556.00, was produced by the county during the years 1919 to 1925 inclusive. Sands suitable for general construction purposes are found as alluvial deposits in the bottoms and on the flood plains of the Kentucky River.

Limestones suitable for rural building, highway and railway bed construction are available in the Knobs in the southern and eastern part of the county. Clays which might be used for brick-making occur both as transported and residual deposits. On lower Miller creek adequate quantities of both limestone and clay are known to exist close to river and rail lines of transportation. These resources are of excellent quality and are regarded as altogether suitable for Portland cement making purposes. An extensive outcrop of the Chattanooga (Devonian) oil shale indicates a large future supply of artificial petroleum available in this district should the natural resource petroleum be exhausted.

A new geological map of Estill County, scale 1 inch equals 1 mile, showing oil and gas structure as well as areal distribution of the rocks and fault pattern is available. Topography has been executed and is presented to the scale of 1:125,000 on the Richmond and Beattyville quadrangles.

XXXIV.

FAYETTE COUNTY.

Fayette County, located in central Kentucky in the heart of the Bluegrass Region, is drained by Elkhorn and Hickman creeks into the Kentucky River. Elongate and irregular in form, it covers an area of 270.15 square miles. It is commonly regarded as an Inner Bluegrass county and its central smoothly undulating terrain inclines one at first glance to this view. The eastern-central part of the county, however, due to the pres-



A BLUEGRASS PASTURE.

Richly phosphatic Ordovician limestones produce in Fayette County soils of unusual excellence.

ence of the Hickman-Bryan Station Fault with downthrow on the east, exhibits a narrow strip of the Eden shale which is Lower Cincinnati (Upper Ordovician), and elsewhere in this part of the State is characteristic of the Outer Bluegrass Region. That portion of the county adjacent to the Kentucky River is hilly and rugged. Lexington, the hub of this delightful agricultural area, is also the county seat of Fayette. The city shows elevations ranging from 957 feet to about 1,000 feet; while elsewhere the county falls away to lower elevations, and at Valley View on the Kentucky River, minimum elevations of about 575 feet are found.

The hard rocks of Fayette County consist entirely of limestones and calcareous shales of the Ordovician System. The sequence begins with the Camp Nelson (High Bridge) and con-



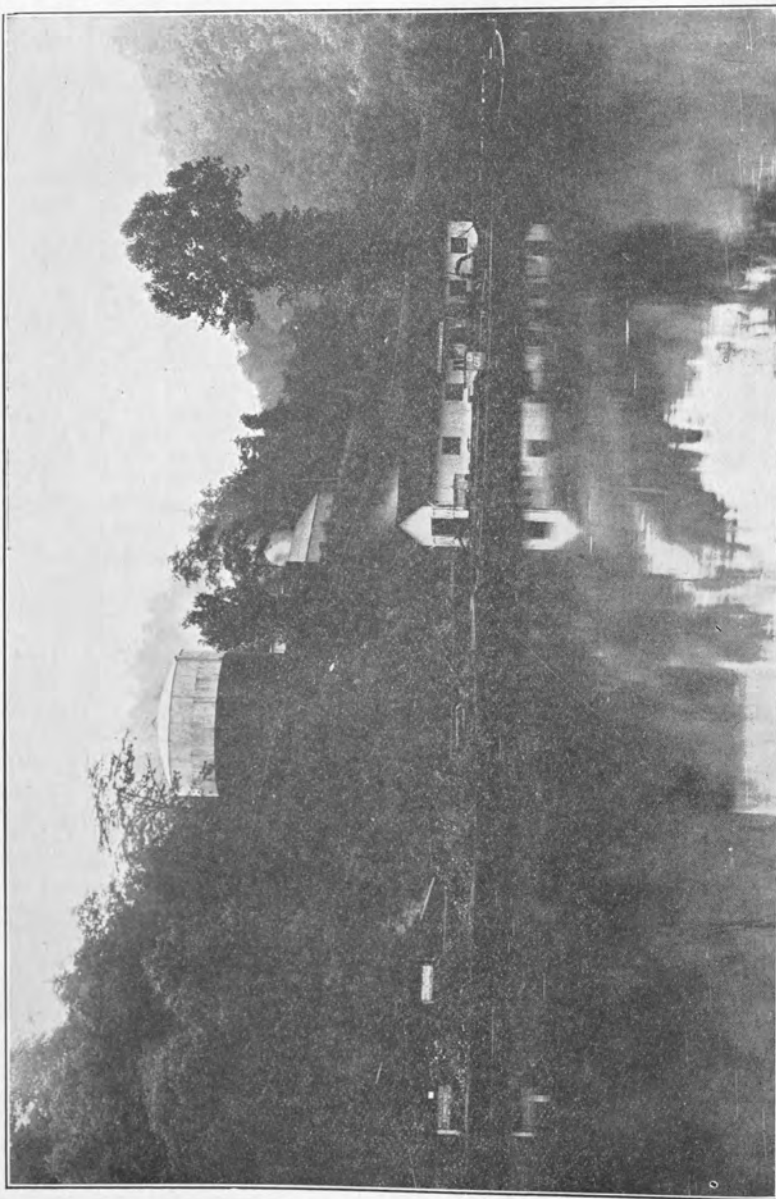
THE "PETRIFIED" FALLS OF ELK CREEK.

This massive deposit of calcareous tufa in the eastern part of Fayette County continues to attract many visitors every year. Prof. A. M. Miller stands at the lower right hand corner.

tinues uninterruptedly up through the Trenton to and including a portion of the Eden shale (Cincinnatian-Upper Ordovician). The Lexington townsite and the western part of the county exhibit Trenton rocks for the most part, while the entire sequence is shown in the east. The rocks exposed along the Kentucky River exhibit some of the oldest sediments in the State of

Kentucky. Throughout the Trenton or Lexington series, and particularly in the upper members, there are highly phosphatic lenses which, after weathering, produce soils of the very first quality. The regional structure of Fayette County is somewhat anticlinal, as this county is situated on top of the Lexington Dome of the Cincinnati Arch. Very low angles occur in the southwestern part of Fayette County adjacent to the Jessamine County line. The eastern part of the county exhibits dips to the southeast, the northern part of the county is inclined to the northeast, and the strata in the vicinity of Donerail and Elkhochester are seen dipping to the northwest. As has been indicated, the county is bisected by the Bryan Station Fault, striking north 45 degrees east from the waters of West Hickman Creek in Jessamine County, passing through Bryan Station and on to the northeast into Bourbon County in the vicinity of Muir. The strata immediately to the east of this normal fault are down-dropped and inclined toward the fault, thus producing a considerable local anticline, the axis of which parallels the fault and passes through the vicinity of Cadentown, its displacement being about 125 feet.

The mineral resources of Fayette County consist principally of limestones, which occur in inexhaustible quantity and requisite quality suitable for rural building, highway and railway bed construction purposes. Sands occurring as transported deposits in the channel of the Kentucky River are used for general constructional purposes. Fayette County contains a number of small generally north-south fissure faults and open joint plane veins of barite, calcite, fluorspar, sphalerite (zinc sulphide), and galena (lead sulphide). The uncommon barium carbonate, witherite BaCO_3 , in crystal form has been found in some of these barite-filled fissures. The barite occurs in a few of these fissure deposits in considerable, possibly workable, quantity, but the associated minerals as indicated above are so limited and disseminated as to be of no commercial value. Residual Ordovician clays suitable for brick-making occur in this county. Occasional apparently inconsequential deposits of oil and gas are known to have been discovered in the Winchester (Upper Trenton) limestones of Fayette County, but no commercial operations have ever been developed.



PETROLEUM PUMPING STATION ON KENTUCKY RIVER.
This operation is located at the mouth of Boone Creek near the Clark County line in the southeastern tip of Fayette.
The hills are of abrupt character cut in Ordovician limestone.

A geological map of Fayette County, produced in 1926, to the scale of one inch equals one mile, is available. Topography for this district has been executed on the Harrodsburg and Richmond sheets 1:125,000, and on the Georgetown and Lexington sheets to the scale of 1:62,500.

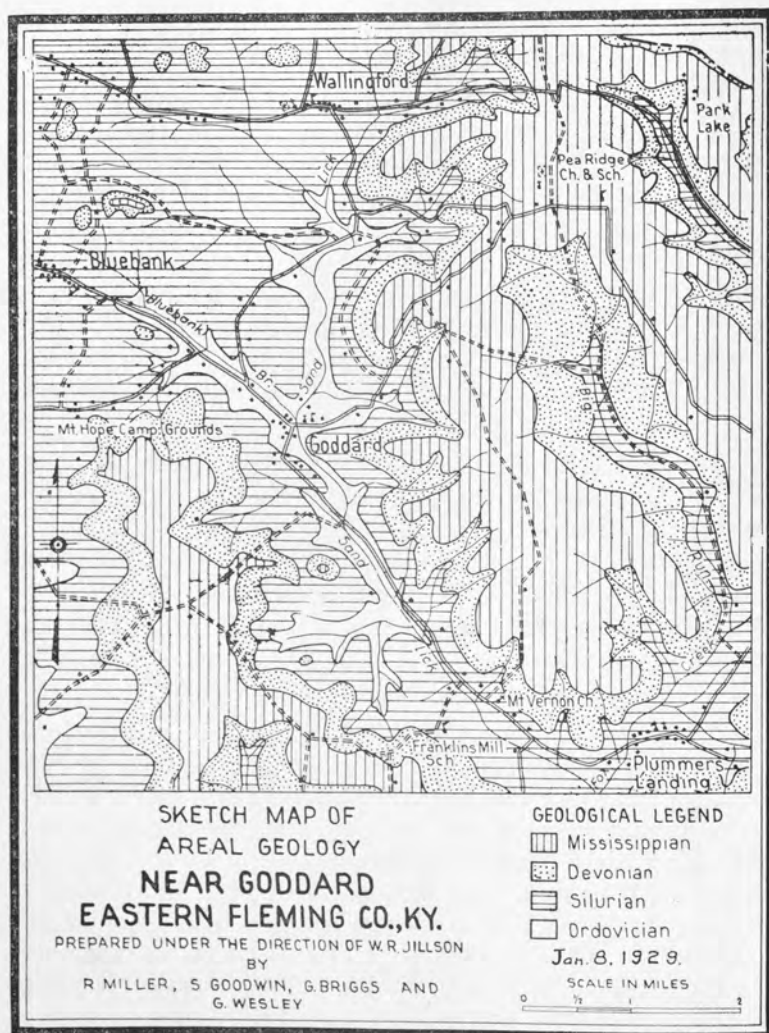
XXXV.

FLEMING COUNTY.

Fleming County is located in Eastern Kentucky on the waters of the North Fork of Licking River. Areally it covers 367 square miles. The western part of the county is properly a part of the rolling to hilly Outer Bluegrass, while the Knobs belt encompasses the eastern portion of the county. The entire terrain of this district is hilly, small areas of flat land being restricted to the valley flood plains of the major streams. Flemingsburg, the county seat, with an elevation of 850 feet, is representative of the limestone uplands, but it is exceeded by 250 feet in the ridges to the southeast along the Lewis-Rowan County boundary.

The hard rocks of Fleming County consist of Cincinnati (Upper Ordovician), principally Maysville and Richmond formations, limestones and shales, and in ascending order involve the Silurian, Devonian, and Lower Mississippian limestones, sandstones and shales. The regional structural aspect of the county is a southeastward dipping monocline which is locally flexed by anticlines and synclines of low angle. No faults of consequence are known to occur in Fleming County.

The mineral resources of this district consist principally of limestones which occur in quantity and quality suitable for rural building, road and railroad bed construction. Sands suitable for all general purposes may be taken from the alluvial deposits of Licking River. A considerable amount of oil and gas prospecting in Fleming County during recent years has resulted in showing the presence of these two minerals in small quantities near Colfax on the Licking River. A considerable outcrop of the Chattanooga (Devonian) shale insures a plentiful source of a supply of artificial petroleum at some future time. Cuyahoga (Lower Mississippian) sandstones of thinly bedded and excellent quality suitable for exterior building stone and other construction, occur in the eastern ridges but are not operated. Fleming County has been glaciated either by outwash or impounded waters, as evidenced by the occurrence of a shattered

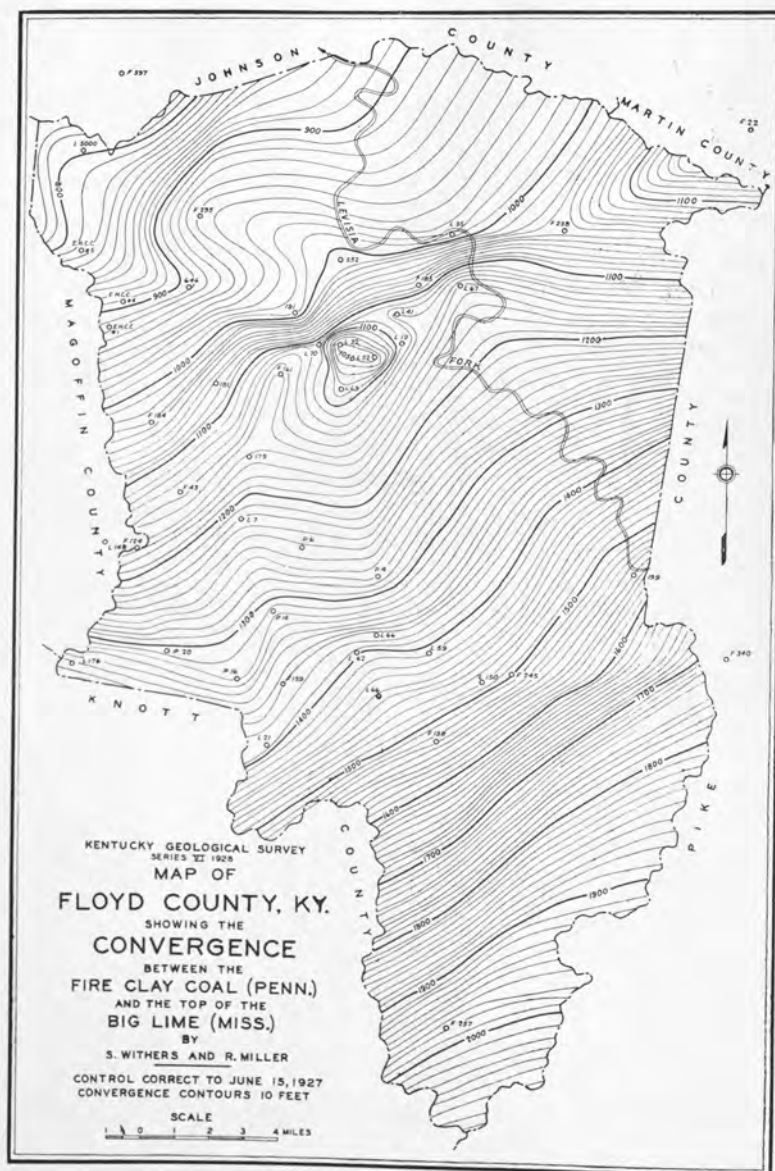


AREAL GEOLOGY NEAR GODDARD, KY.

The Ordovician inlier indicates a doming anticline is present in this locality. It is untested.

Canadian gneissic boulder weighing upwards of 15 tons, found on Beechy Creek, Lewis County, about four miles southeast of Foxport and close to the Fleming line.

Fleming County was mapped geographically in 1925 to the scale 1 inch equals 1 mile. No topographic surveys have been completed for this district.



CARBONIFEROUS CONVERGENCE IN FLOYD

XXXVI.

FLOYD COUNTY.

Floyd County is located in the Eastern Kentucky Coal Field and throughout is typical of the "Mountain" Region of Kentucky. Physiographically it is a part of the maturely dissected Cumberland Plateau. In area it covers 405.42 square miles. The master drainage of this district is the Levisa Fork of the



THE KENDRICK FOSSIL SHALE.

The type locality discovered by the writer in 1919 on the head of Cow Creek of Big Sandy River in Floyd County is here depicted. It is an important Pottsville stratigraphic unit.

Big Sandy into which flow such local major tributaries as Abbott Creek and Middle Creek, Beaver Creek, Mud Creek and Johns Creek. Prestonsburg, the county seat of Floyd County, has an elevation of 641 feet and is located on the flood plain in a broad meander of the Big Sandy. Ridge top elevations surrounding and to the southeast attain heights ranging from 1,250 to 2,150 feet.

The hard surface rocks of Floyd County consist of occasional very thin limestones, thick, massive and thin bedded sandstones, shales and coals of the Pottsville (Lower Pennsylvanian) series. Some of the ridge strata adjacent to both Martin County on northeast and Magoffin County on the southwest carry remnants of the overlying Allegheny formation which else-

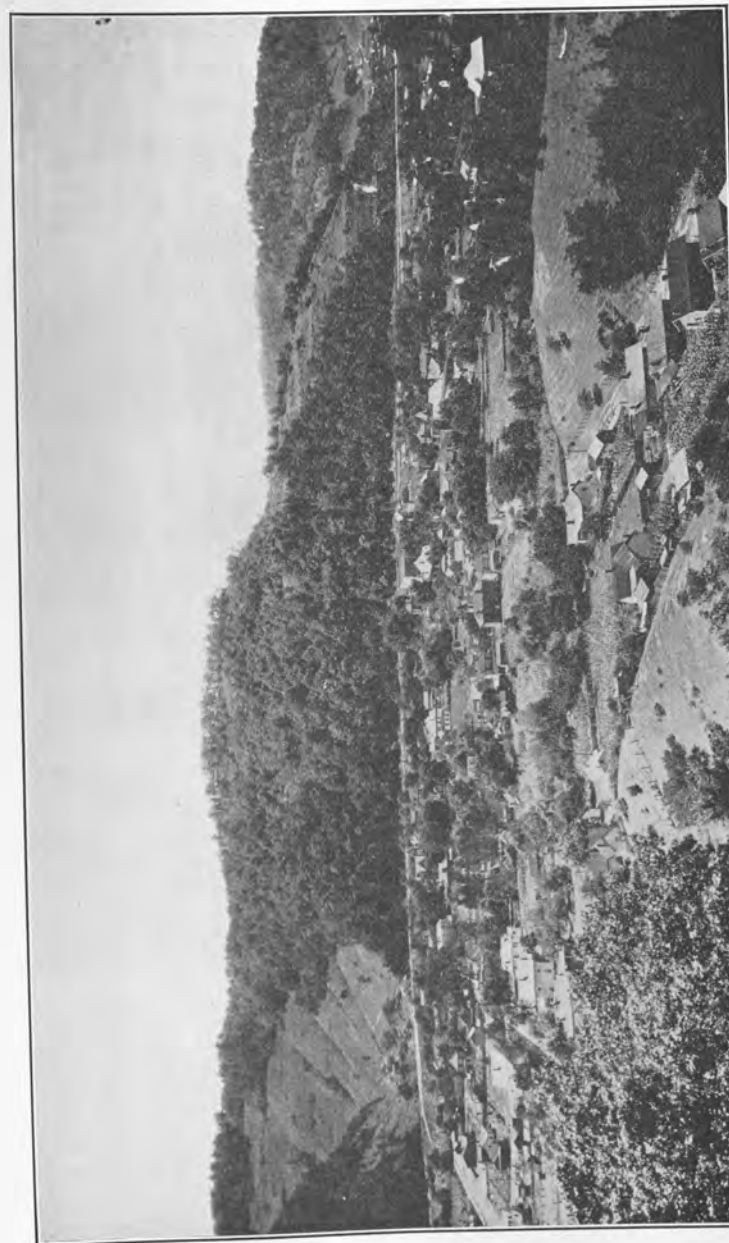
where has been entirely removed by erosion. The valley bottoms contain alluvial clays, sands, gravels, of Pleistocene and Recent age. The regional structure is geo-synclinal, the great Coal Measure trough of Eastern Kentucky passing northeastwardly through the county.



OLD TIME RIVER ROAD IN FLOYD.

Sandy shales and sandstones of Pottsville age are found at frequent outcrop along this old dirt road from Prestonsburg to Brandykeg and Beaver creeks.

The two principal mineral resources of Floyd County are bituminous coal and natural gas. The exposed section of the Coal Measures in this district exhibits about eight seams, of which the following four: (1) Van Lear, (2) Wayland, (3) Lower Elkhorn and (4) Fire Clay coals are of commercial importance. The best coal deposits occur in the southern and eastern parts of the county. In 1925 Floyd County produced 4,851,721 tons of coal. Natural gas is produced throughout central-western and the northwestern part of the county, principally from the "Maxon," "Big Injun," "Berea" (Mississippian); and "Ohio" shales (Devonian) "sands" at depths ranging from 1,000 to 2,200 feet. Oil has a rather wide occurrence in small quantities in Floyd County, and has been produced in commercial quantity on Right Beaver Creek near the mouth of Salt Lick for 35 years, the original production having been drilled in



PRESTONSBURG: MOTHER TOWN OF THE BIG SANDY COUNTRY.

Settled before statehood it became the first county seat of Eastern Kentucky in 1799. Judge John Graham, pioneer settler and Revolutionary soldier gave the streets and the court house square to Floyd County and named the town for his friend John Preston of Virginia. The corporation occupies all of a broad flood plain in a meander of the Levisa Fork. The topography is typically Pottsville.

during 1891. Sandstones suitable for bridge abutment and other rough construction purposes are available, and loose sand sufficiently clean and sharp for constructional purposes is found as transported deposits in the creek bottoms throughout the county.



A GLIMPSE OF THE BIG SANDY.

This view shortly below Dwale shows a sharp meander in the stream and steep forested hills which are quite typical of Floyd's landscape.

Brines were formerly produced on left Middle Creek near Blue River postoffice from shallow wells for salt manufacture, but this industry has long since been abandoned.

Separate surface and subsurface structural geological maps of Floyd County of recent date are available scaled 1 inch equals 1 mile. A recent oil and gas map of the county in colors at the scale of 1 inch equals 1 mile is also available. The topography has been delineated to the scale of 1:62,500 on the Prestonsburg, Harold, Pikeville and Hindman quadrangles.

XXXVII.

FRANKLIN COUNTY.

Franklin County is situated in the heart of the Bluegrass region of Kentucky being traversed on a generally north and south line by the deeply trenched or gorged Kentucky River. It is hilly throughout, only very restricted areas of upland being undulatory. Small in area, it encompasses only 199 square miles.



SALVISA BED OF THE PERRYVILLE.

Well toward head of Devils Hollow on Benson Station pike this section shows the Cynthiana limestone under the contact indicated by E. O. Urich in 1913.

Frankfort with an elevation of 511 feet located on a double meander of the Kentucky River is depressed in its topographical aspect from 300 to 450 feet below the ridges and uplands surrounding.

The rocks of Franklin County consist of Ordovician limestones of both the Champlainian and Cincinnati series. An excellent Trenton section is exposed. The regional structure of Franklin County is essentially a monocline dipping to the northwest due to the fact that this county is located high on the northwest flank of the Lexington Dome of the Cincinnati Arch. The county is traversed by a zone of faulting which strikes north



FRANKFORT IN THE KENTUCKY RIVER VALLEY.
This panorama from the grave of Daniel Boone well exhibits to what extent the great master stream of Central Kentucky has trenched itself into the old Tertiary plain of the Bluegrass Region.

55 degrees west through Switzer toward Peaks Mill and the lower waters of Elkhorn. The displacement along this fault zone ranges from 25 to 100 feet.

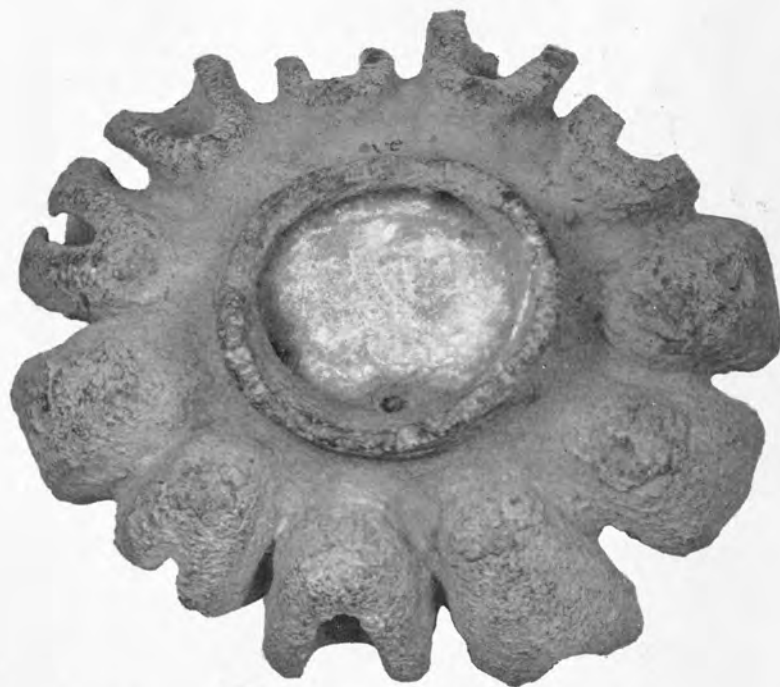
The mineral resources of Franklin County consist principally of limestones and clays. Along the waters of the Kentucky River the Tyrone limestone is exposed. A highly desirable build-



AFTER A DAY AFIELD.
Franklin County's rocky stream beds and limestone caves give excuse enough for young geologists three, Williard, Jr., Oriole and Marie Jillson, to taste camp fire dainties—coffee, bacon and beans.

ing stone chalky white in appearance, it has been used widely throughout this part of Kentucky for all general constructional purposes including the building of the Old Capitol which was completed in 1829. Other limestones suitable for rural building, highway and railway bed construction are found widely distributed and are freely used. Clays suitable for ordinary brick making occur as both residual and transported deposits, and of the latter a light gray upland fluvatile clay of Pliocene age is available in the Farmdale district, but now unused, for the making of stoneware and art pottery. Limestone, shales and clays suitable for Portland cement making exist in large quantities. Natural gas in small and uncommercial quantities, and mineral waters of reputedly high therapeutic value occur, but are practically unused in Franklin County.

The county has been mapped to the scale of 1:62,500, and its topography has been executed at the same scale on the Frankfort, Lockport, Mt. Eden, Georgetown, and Sadieville sheets.



BRACHIOSPONGIA DIGITATA.
A rare Franklin County Fossil Sponge from the brannon (Ordovician) limestone.

XXXVIII.

FULTON COUNTY.

Fulton County is situated in the westernmost part of Kentucky adjacent to the Mississippi River and Tennessee line. The district is typically "Purchase" of which region it forms the southwestern part covering an area of 209 square miles. The principal drainage is through Obion Creek and Bayou de Chien



THE MISSISSIPPI RIVER FROM HICKMAN HEIGHTS.
Tertiary uplands afford excellent opportunities for visual surveys of the great master stream of North America. Fulton has a greater river front on the Mississippi than any other county in the Jackson Purchase.

to the Mississippi River and into Reelfoot Lake. Two readily recognized physiographic districts are embraced within Fulton County: (1) the Big Bottoms of the Mississippi River including Island No. 8, and (2) the central eastern undulating uplands. Hickman the county seat with an elevation of 360 feet is partly in each province. The Mississippi River bluffs in this vicinity rise to an elevation of 461 feet, but the uplands generally average about 400 feet, while low water at Hickman is 257 feet.

Stratigraphically the sediments of Fulton County are separable into district groups: (1) Alluvial deposits of Recent and Pleistocene age in the Big Bottoms, and (2) Tertiary sands, clays, and gravels with Pleistocene overlay of loess for the southern central uplands. The unconsolidated rocks of this county

give but slight surface clue as to their normal bedded inclination, but a calculation of the depths at which recognizable Cretaceous and older subsurface sediments are found in deep drilled wells, indicates that the normal dip of the beds in this part of Kentucky is to the southwest. Other structural features are known merely by inference. The occurrence of frequent earthquakes of greater or less significance in this part of Kentucky since the New Madrid earthquake of 1811 and 1812 which formed Reelfoot Lake, has led to the opinion that the Paleozoic floor underlying this county is rather complexly faulted, and that some of these fissures are still lines of more or less active movement.

The principal mineral resources of Fulton County consist of upland clays and gravels. The clays are suitable for ordinary brick and some kinds of pottery manufacture, while the gravels have been used to a considerable extent for local building construction and highway improvement. Some deposits of clays in the Big Bottoms of the Mississippi River might be used for brick making purposes. Small artesian and pumped well water has also been used in this district.

A geographic map of Fulton County prepared in 1925 to the scale 1 inch equals 1 mile, is available. The topography of this district has not yet been surveyed. The Mississippi River, however, has been completely surveyed and these maps for all of that part of the stream touching Kentucky are available from the Mississippi River Commission at St. Louis.

XXXIX.

GALLATIN COUNTY.

Gallatin County is situated in northern Kentucky adjacent to the Ohio River and to the State of Indiana. Its 109 square miles is drained by minor tributaries of Eagle Creek and Ohio River. Physiographically the district as a whole is maturely dissected, consisting of sinuous uplands of which the ridge be-



EAGLE CREEK VALLEY, GALLATIN COUNTY.

An unusual and as yet unexplained sharp bend to the west in this stream's course above Glencoe and near the Grant County line has been noted by many geologists.

tween Eagle Creek and the Ohio River is most pronounced. A well defined flood plain follows the Ohio River, and Warsaw, the county seat, is here located at an elevation of 495 feet. The district is a part of the hilly Outer Bluegrass.

Stratigraphically the hard rocks consist of Ordovician limestones and shales ranging upwards from the Trenton through the Maysville and Richmond formations. The Eden shale, washing badly here as elsewhere, is exposed on most of the steep slopes. Structurally, because of its location on the northwestern flank of the Lexington Dome of the Cincinnati Arch, the normal inclination of the bedded rocks of this county is to the northwest. While minor folds are found in Gallatin County, faults of major significance are not known to occur.

The principal mineral resource of Gallatin County is limestone. It occurs in wide distribution suitable for rural building construction, highway and railway bed use. The Ohio River affords an inexhaustible supply of both sand and gravel, and each of these may also be secured from some few upland and flood plain deposits of glacial origin. Springs emanating from the Middle Ordovician beds produce the well known sulphur saline mineral waters similar to those emanating from Big Bone Springs in Boone County adjoining.

A geographic map of Gallatin County, scale 1 inch equals 1 mile, is available, but the topography of this district has not been surveyed. Field work on the Rising Sun sheet is now, however, in progress and this when finished during 1929 will exhibit that portion of the county touching the Ohio River.

XL.

GARRARD COUNTY.

Garrard County is situated in the southern Bluegrass Region of Kentucky. The northern tip of the county extends well into the Inner Bluegrass at the juncture of the Dicks and Kentucky rivers, while the southeastern tip of the county penetrates into the Knobs Belt. It covers an area of 250.73 square

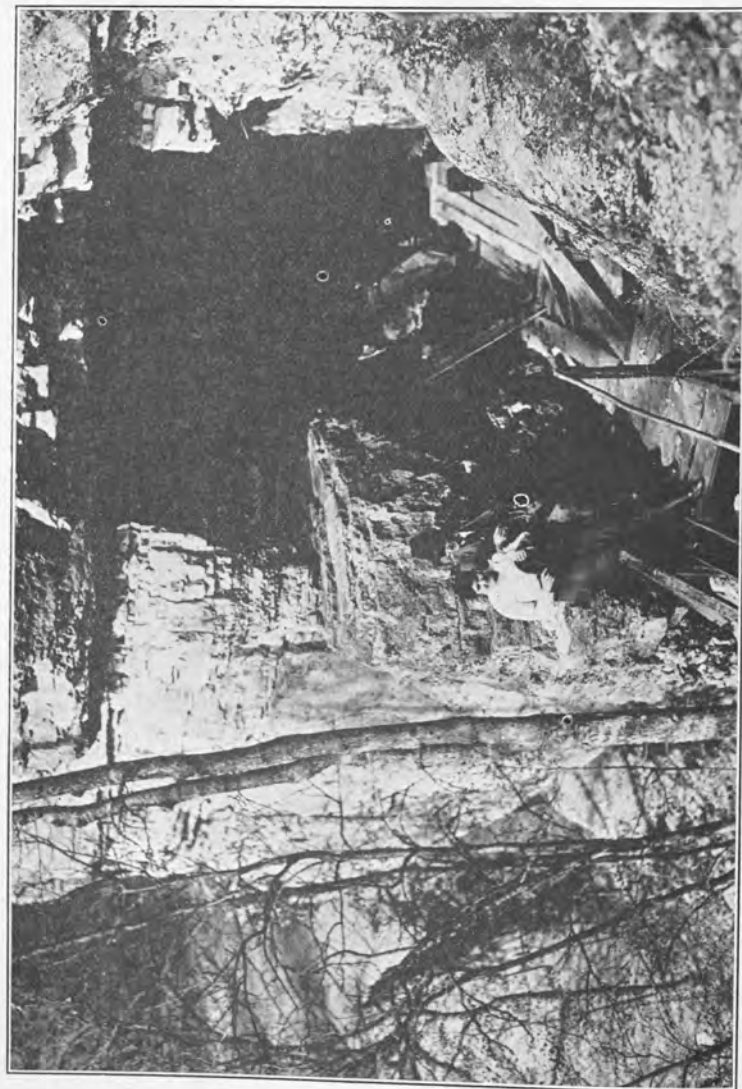


INTERIOR OF POWER HOUSE, DIX DAM.

Each of these three hydro turbine generators produces 10,000 H. P. of electric current. The control boards are glass enclosed at the left.

miles. Lancaster, the county seat, has an elevation of 1,032 feet which is equivalent to many upland areas in the county. The minimum elevation of about 525 feet is found at the mouth of the Dicks River, while the maximum elevation of 1,300 feet occurs in the Knobs in the southeastern portion.

Stratigraphically Garrard County exhibits a very long section from the lowermost Ordovician sediments, the Camp Nelson limestone on the north, to the Middle Mississippian in the Knobs on the southeast. This section includes all of the Ordovician sequence in Kentucky, the Silurian, the Devonian and all of the Lower Mississippian up to and including the lower part of the Warsaw limestone.



A CELEBRATED KENTUCKY RIVER CAVERN
This Garrard County cave ascribed to Daniel Boone occurs in soluble Ordovician limestone high above the river. A small stream issuing from it spreads a fine spray over the cliff side below and in so doing has deposited much calcerous tufa.

Structurally the normal regional dip of the county is to the southeast, its position being on the southeastern flank of the Lexington Dome of the Cincinnati Arch. This normal dip, however, is locally changed and in some places reversed due to many flexures and much faulting, the latter frequently of major proportion. The Kentucky River Fault joined by the Hickman Creek Fault passes through the northwestern part of the county, striking nearly south 20 degrees west through the Burdett's Knob district. In Garrard County it is known as the Bryantsville Fault Zone and at least five separate displacements are of record. The Burdett Knob is itself a pronounced graben exhibiting on its slope Upper Ordovician, and on its crest Devonian and Mississippian sediments—true outliers. A continuation of the Irvine-Paint Creek disturbance so well known in Eastern Kentucky passes through the southern part of the county striking about south 75 degrees west. It is known in Garrard County as the Button Lick and Pine Knob Fault. Between these nearly parallel faults a rather pronounced graben is developed. The central southern portion of the county is bisected by still another break — the Cartersville Fault striking north 45 degrees west. All of these are normal or tension faults.

The principal mineral resource of Garrard County is limestone which occurs in inexhaustible quantity and in quality suitable for many grades of building and highway construction. It also offers grades suitable for purposes of general building construction. The southern tip of the county crossed by outcrop of the Chattanooga (Devonian) black shale affords a plentiful supply of raw material for the manufacture of artificial petroleum at some future time if necessary.

A geological map of Garrard County, scale one inch equals one mile, is available, bearing date of 1927. The district has been surveyed topographically on the Richmond and Harrodsburg quadrangles, scaled 1:125,000.



KENTUCKY RIVER CHIMNEY ROCK.

This pedestal of Ordovician limestone is one of the scenic attractions of northern Garrard County. It occurs about two miles west of the Nicholasville-Camp Nelson road high above the river level.

XLI.

GRANT COUNTY.

Grant County is located in northern Kentucky and is typically a part of the Outer Bluegrass district. Eagle Creek an important tributary of the Kentucky River drains the western part of the county, while the eastern portion is drained by tributaries of the Licking River. It covers an area of 268.41 square miles. Williamstown, the county seat, has an elevation of



EDEN SHALE NEAR CORINTH

975 feet which is in general the equivalent of the ridge elevations of the entire district. Physiographically, Grant County is a part of the maturely dissected Lexington Plain and exhibits only very restricted areas of either flat bottom or upland. The relief of the county is about 300 feet.

Stratigraphically, Grant County exhibits principally Upper Ordovician sediments, limestones, shales and occasional thin sandstones. The section begins near the top of the Trenton and extends up through the Eden shale and ends in the Maysville and Richmond. The central and larger part of the county is embraced within the outcrop of the latter two formations. Structurally the county is close to the crest of the Cincinnati Arch on the northern flank of the Lexington Dome. It exhibits,

therefore, a normal regional dip of its beds to the northwest. There are no pronounced faults of record in Grant County.

The principal mineral resource of Grant County is limestone, which is available in inexhaustible quantity and quality



TYPICAL GRANT COUNTY TOPOGRAPHY

Elongate incised ridges of uniform height, largely in open farm or pasture land characterize the waters of Grassy Creek west of Mason Station as seen here.

suitable for rural building, highway and railroad bed construction. Springs emanating from the Middle Ordovician series beneath this county produce sulphur iron waters quite characteristic of both Blue Lick and Big Bone Springs.

A new geographic map of Grant County, scale 1 inch equals 1 mile, is available. It is unsurveyed topographically.

XLII.

GRAVES COUNTY.

Graves County is located in the heart of the Jackson Purchase Region of western Kentucky. Encompassing about 551 square miles, it is one of the larger counties. On the south it extends to the Tennessee line. The terrain of Graves County is



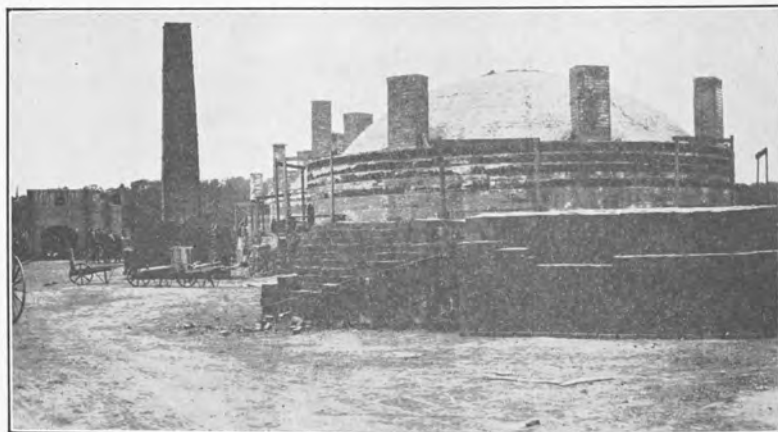
CLAY PIT NEAR PRYORSBURG.

One of the most important mineral resources of Graves County is clay, but sand and gravel are also important.

gently undulating to rolling, and in some regions hilly. Mayfield the county seat, with an elevation of 425 feet, has a somewhat central geographic position. The principal drainage of Graves County is effected through the North Fork of Obion River, Obion Creek, Bayou de Chien, Mayfield Creek and West Fork of Clarks River.

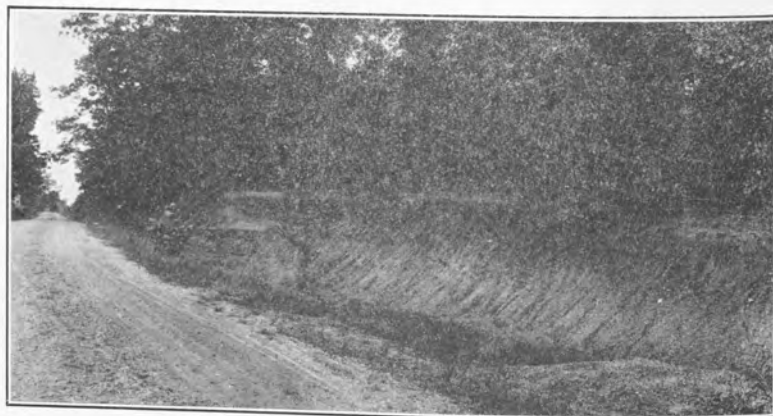
The rocks of Graves County are all unconsolidated sediments, sands, gravels, clays, silts and lignites of Tertiary and Recent age. The structure of Graves County is not revealed by the surface formations, but is inferred from deep well drilling both in this and adjoining counties, to be essentially monoclinial with a pronounced dip to the southwest. Although no faults are

observable at the surface, the nature of the fault pattern of those parts of Kentucky and Illinois which are adjacent to the Jack-



BRICK PLANT AT MAYFIELD.

Graves County clays are used for various purposes including brick manufacture.



A WAYSIDE GRAVEL PIT.

Many such convenient deposits of good road materials occur in Graves. This opening is near Wingo.

son Purchase indicate that the Paleozonic floor of this region is very complexly faulted, with a somewhat radial pattern emanating from northern Graves County.

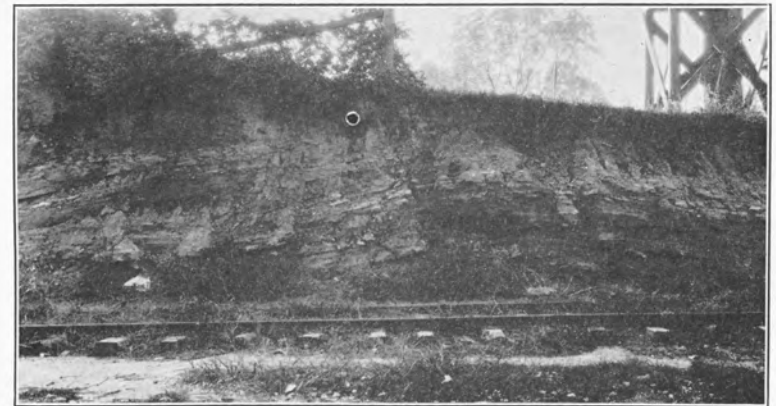
The mineral resources of Graves County consist of clays and gravels. The clays are divisible into sagger and ball clays, each of which has a considerable demand. The largest operations are near Pryorsburg and Mayfield. Some residual clays are used for brick-making purposes. Gravels are used for road-building purposes. A number of excellent pumping water wells of small productivity have also been developed. Lignites occur, but are of no commercial value at the present time.

A geographic map of Graves County, scaled 1 inch equals 1 mile, is now available. This county was included in the small scale geological map of the entire Jackson Purchase, issued by the Second Geological Survey about 1888. It is unsurveyed topographically.

XLIII.

GRAYSON COUNTY.

Grayson County, covering an area of 537.40 square miles, is located in west central Kentucky. It is drained by Rough River, Nolin River and Bear Creek, the latter two being tributaries of Green River. This portion of the State is hilly throughout, except in the northeastern sections of the county where a well marked plateau on the Golconda limestone is trenched by



ANTICLINE AND FAULT AT LEITCHFIELD.

This cut on the Illinois Railroad shows a part of the Rough Creek Disturbance an important structural factor in the economic geology of Western Kentucky.

somewhat precipitous drainage. Leitchfield, the county seat, with an elevation of 752 feet, is exceeded by uplands to the southeast, particularly Buzzard Ridge, which attains an elevation of 950 feet. Minimum elevations are found at the Ohio County line on Rough River.

The hard rocks of Grayson County consist of limestones, sandstones, and shales of the Chester (Upper Mississippian) and Pottsville (Lower Pennsylvanian) systems. The structure of the county is in the nature of a monocline tilted to the southwest, which has been fractured throughout by the Rough Creek disturbance along a line striking slightly south of east. The

displacement along this fault which is normal varies from 10 to 80 feet. It crosses the Illinois Central railway just east of Leitchfield.

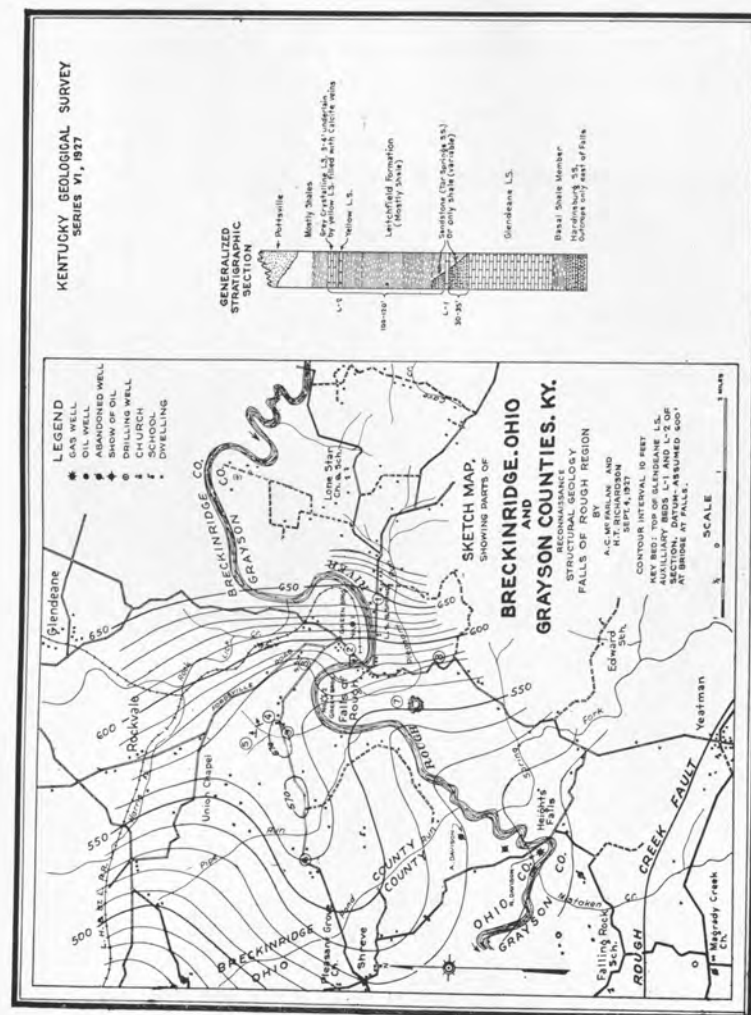
The principal mineral resource of Grayson County is bituminous sandstone. It is known commercially as rock asphalt. The deposits occur as asphaltic impregnated lenses of the basal Pottsville and also in the underlying Cypress (Chester) sand-



A GRAYSON COUNTY ASPHALT QUARRY.

Cypress sandstone (Chester) is here being operated, but Pottsville sandstones also contain asphalt in this part of Kentucky.

stones. One or two plants are operated at the present time in this district. Oil in small quantities, and natural gas in larger and commercial quantities, have been developed in the vicinity of Leitchfield on structure and at points to the west and south. Limestones suitable for rural building, highway and railroad-bed construction are present in the northern and eastern parts of Grayson County. Drilled wells produce saline waters, but these are not used. Some secondary mineralization has taken place along the Rough Creek Fault and in a few localities small deposits of spalerite (zinc sulphide), galena (lead sulphide), and calcite (calcium carbonate) have been found, but none of these minerals have been commercialized. Calcareous marls suitable for direct utilization as agricultural fertilizers are avail-



SKETCH OF STRUCTURE AT FALLS OF ROUGH

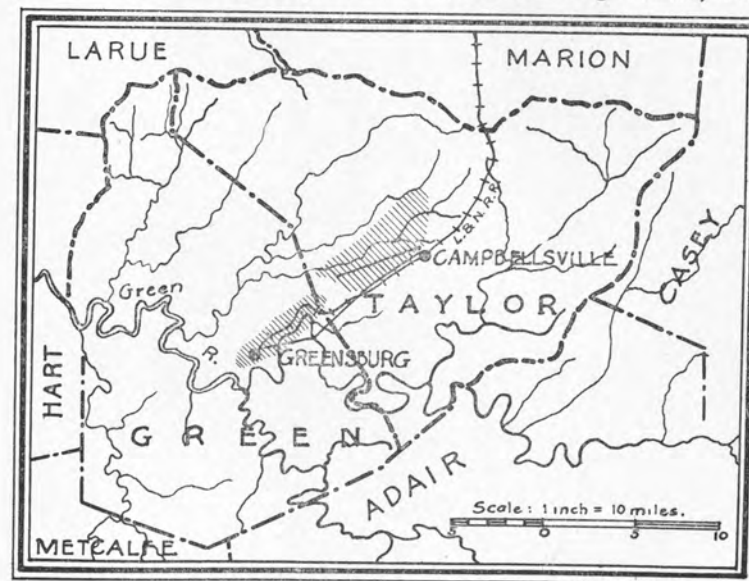
able in small quantity in the vicinity of Leitchfield. Clays suitable for brickmaking are available.

A new oil and gas, and rock asphalt map, scale 1 inch equals 1 mile, is available for this county. The topography of the southern half of Grayson County has been executed on the Leitchfield, Cub Run, and Spring Lick quadrangles, scale 1:62,500. The northern part of the county is now in course of being surveyed topographically.

XLIV.

GREEN COUNTY.

Green County is located in central southern Kentucky, well within the eastern Pennyroyal. It is drained entirely by the Green River, the principal local tributaries being Russell, Put-



SKETCH OF GREEN AND TAYLOR GAS FIELDS.

Commercial natural gas production comes here from "sands" at relatively shallow depths below the Devonian black shale. The volume is adequate but the rock pressure is slight.

nam, and Little Barren rivers. Areally it covers 292.04 square miles. The county is hilly throughout. Greensburg, the county seat of Green County, on the Green River, has an elevation of 575 feet, but ridges in this district rise to elevations of from 250 to 300 feet higher.

The structure of Green County is a gently dipping monocline tilted slightly to the west of south. No faults of consequence are known to occur in this county.

The principal mineral resource of Green County is limestone, which is found in quantity and quality suitable for rural

building, highway and railway-bed construction. Natural gas in considerable quantities, produced from the "Corniferous" limestone of shallow depths, has been developed in the pool which continues northeast into Taylor County to the vicinity of Campbellsville. Some oil has also been found in Green County, but in small quantity. Alluvial and residual clays are available for local brick-making purposes.

An oil and gas map of Green County, published in colors in 1928, is available. This region is unsurveyed topographically.

XLV.

GREENUP COUNTY.

Greenup County is located in the northern tip of the Eastern Kentucky Coal Field adjacent to the Ohio River and the State of Ohio. It is drained principally by the lower waters of Tygarts Creek and Little Sandy River, both being northeast



RUINS OF RACCOON IRON FURNACE.

The iron industry making use principally of carbonate nodules was once important in Greenup County but has long since been abandoned. Modern furnaces and mills using ores from the Great Lakes deposits now greatly exceed the values produced years ago in the "Hanging Rock" district.

flowing tributaries of the Ohio. Its area is 387.8 square miles. Greenup, the county seat, has an elevation of 540 feet on the flood plain of the Ohio, but elevations on the ridge to the west and south rise 250 and 300 feet higher. The minimum elevation is slightly west of Fullerton on the Ohio River. The district is part of the maturely dissected Cumberland Plateau, the hills being steep and narrow and generally timbered. The valleys are meandering and include but small amounts of flat alluvial land.

The hard rocks of Greenup County consist of limestones, sandstones, cherty sandstone conglomerates, shales and coals of the Upper Mississippian and Lower Pennsylvanian systems. The

structure of the county is monoclinal, the dip being to the southeast about 25 to 35 feet per mile. A few plunging anticlines of low figures strike southeastwardly across the district. There are no faults of consequence in Greenup County.



TOPOGRAPHY OF THE TYGART VALLEY REGION.

Both Mississippian and Pennsylvanian sediments are exposed in the hills near the mouth of Brushy Creek.

The principal mineral resource of Greenup County is coal which is produced from a few rather thin seams for domestic purposes. Limestone is available near Limeville, and small amounts of oil and gas have also been found. Cannel coal was formerly produced near Honeywell. These deposits have not been worked out. Sands suitable for general constructional purposes are available in unlimited quantities from the Ohio River, and alluvial clays are present suitable for ordinary brick making. Some residual upland clays-shales might be used for face brick making.

Separate geographic and structural oil and gas geological maps, scaled 1 inch equals 1 mile, of Greenup County are available. The Greenup Sheet, comprising the Ohio River part of the district, was executed to the scale of 1:62,500 in 1926.

XLVI.

HANCOCK COUNTY.

Hancock County is located in northwestern Kentucky adjacent to the Ohio River and State of Indiana. It covers an area of about 193 square miles. The district is typical of the periphery of the Western Kentucky Coal Field and is rolling to hilly throughout, except along the Ohio River where broad al-



AN OIL LEASE NEAR PELLVILLE.

Hancock County wells in this vicinity start in the Pennsylvanian but produce from Chester sandstones.

luvial bottoms are present. Hawesville, the county seat, has an elevation of 380 feet close to the Ohio, but the ridge tops to the south rise from 200 to 250 feet higher.

The hard rocks of Hancock County consist of sandstones, sandstone conglomerates, shales and coals of the Pottsville (Lower Pennsylvanian) System; and marls, limestones and shales of the Chester series (Upper Mississippian) underlying. The Coal Measures cover the entire county with exception of a small boundary along the Breckinridge County line in the eastern part of this district. The structure of Hancock County is a monocline, the tilt being to the west. The regional altitude of the bedded rocks is flexed by a number of minor anticlines and is crossed by one or two faults of local significance particularly in the vicinity of Hawesville and near where the Breckinridge-Hancock line touches the Ohio River.

The principal mineral resources of Hancock County are coal and petroleum. Several coal seams are known to occur in this county, but of these the Hawesville is of chief commercial importance. Oil is secured in the vicinity of Pellville from the Stephens, Jett, Jackson and Barlow sands, all of which are Chester (Upper Mississippian) and are found at relatively shallow depths. A small amount of natural gas has been produced in



A GLIMPSE OF INDIAN LAKE.
Surrounded by dense timber and cliffs of Pottsville sandstone-conglomerate this is one of the beauty spots of Hancock County. It adjoins the Midland Trail, U. S. Route 60.

this county. Sands and gravels suitable for general construction purposes are available from the Ohio River in inexhaustible quantities, and some residual deposits of gravels are available in the eastern part of Hancock County in the vicinity of Hawesville and elsewhere. Massive sandstones have been used for local building and bridge abutment construction.

A new oil and gas map of Hancock County, scale 1 inch equals 1 mile, is available. The topography of the western part of this county has been executed and is presented on the Tell City and Whitesville sheets, 1:62,500. The Cannelton and Falls of Rough topographic sheets are now in course of field survey.

XLVII.

HARDIN COUNTY.

Hardin County is located in central western Kentucky well within the northern Pennyroyal. Although its northern tip touches the Ohio River, the county is principally drained by Rolling Fork of Salt River, and the Nolin and the Rough rivers



NEW PIT IN HARDIN COUNTY ASPHALT.

The bed opened in prospecting here is the Cypress sandstone. A large operation is established at Summit in the western part of the county but there are many undeveloped and unoperated deposits. The underlying Sample sandstone is also somewhat asphaltic in this region.

which are southwestward flowing tributaries of the Green River. It contains about 606 square miles and is for the most part a gently undulating to rolling plateau. Elizabethtown, the county seat, is located at an elevation of 683 feet in the central eastern part of this upland plain. The northeastern part of the county bounding Bullitt and Nelson along the Salt River is very hilly, and the same may be said of the lower stretches on the waters of the Nolin and Rough River drainage in the southwestern and western parts of the county, this latter district being typically

clifted. The lowest elevation, 425 feet, is found a little below West Point on the Ohio River.

The hard rocks of Hardin County consist of limestones, sandstones and shales principally of Mississippian age. Small areas of Devonian and Silurian limestones and shales are present on the northeastern boundary in the valley of Rolling Fork of



SILICA SAND AT TIP TOP.

There are many excellent deposits of soft sand and friable sandstone in Hardin County. These sands at Tip Top are thought perhaps to have been Cypress (Chester) in origin and age later dropped into a pre-Pleistocene sinkhole and disintegrated in place.

Salt River. Alluviums of Recent and Pleistocene age occur along the Ohio River. The structure of Hardin County is a monocline tilted to the west and flexed by a number of low angle faults, but unfaulted in a major way so far as is now known.

The principal mineral resource of Hardin County is bituminous sandstone known commercially as rock asphalt which is produced in the vicinity of Summit. The producing horizon is the Cypress (Mississippian) sandstone which occurs in a considerable territory of western Hardin County in the Clifty region adjacent to the headwaters of the Rough River. Vast undeveloped reserves of rock asphalt exist in this part of the county, particularly on the waters of the Big and Little Meeting creeks. Limestones suitable for building purposes, railroad ballast, and railway bed construction are of wide occurrence. Many residual sand deposits are known in Hardin County and those at

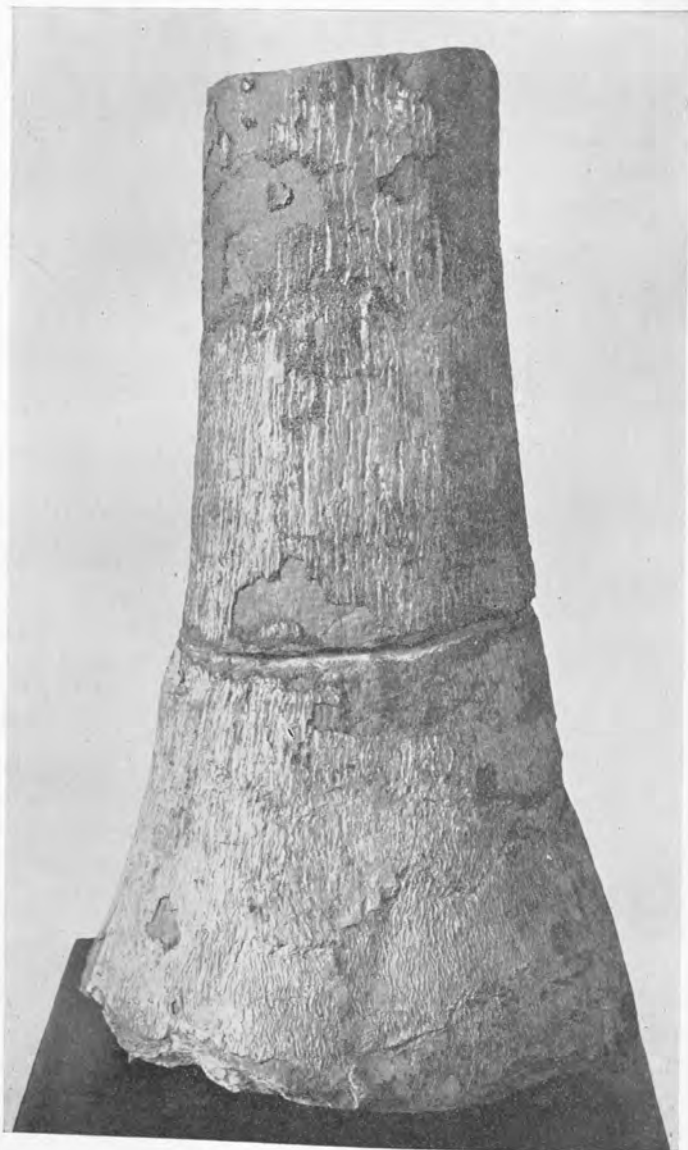
Tiptop are of "first quality." Transported sands and gravels suitable for road construction and building construction may be secured from the Ohio River, and residual clays suitable for brick making occur at numerous points throughout the county uplands. Oil and gas have not been secured in commercial quantities but the ultimate possibilities from the "Corniferous" sand are considered to be good.



GYPSUM ON QUARTZ.

This specimen came from an old quarry near West Point in Hardin County.

An oil and gas map, scaled 1 inch equals 1 mile, of Hardin County dated 1925, is available. Certain portions of the Government military reservation in the vicinity of Camp Knox have been topographically surveyed at a large scale and are available from the Department of U. S. Engineers at Washington, D. C. With the exception of western Hardin, where the Big Clifty Quadrangle covering the area between Stephensburg and Summit was nearly completely mapped in 1925, little topographical work has been done in this county except on the Vine Grove Quadrangle, the field work of which is now in progress.



A COAL MEASURE FOSSIL TREE
This unusually fine specimen of *Lepidodendron* was presented to the Kentucky Geological Survey by the Fordson mines in Harlan County in 1923.

XLVIII.

HARLAN COUNTY.

Harlan County is located in southeastern Kentucky adjacent to Virginia. It is typically an Appalachian Mountain Region of steep, high, densely timbered ridges and narrow meandering valleys. Areally it covers 484.56 square miles. Two mountains of elevation, the Pine and Cumberland, exhibiting crestral eleva-

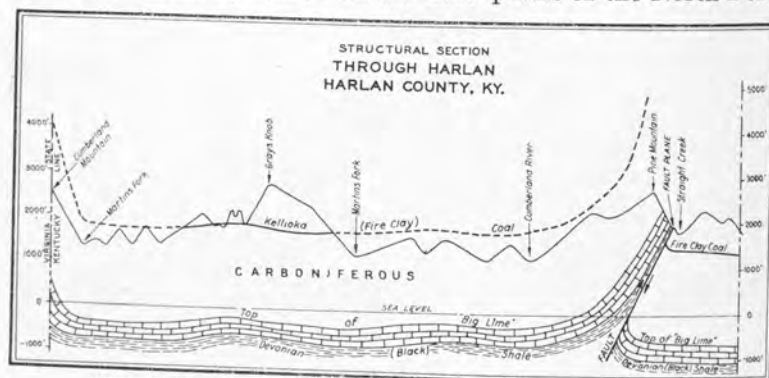


IN THE HEART OF THE CUMBERLANDS.

This view on Martins Fork near Chevolet in Harlan County is typical of this district's topography.

tions ranging from 2,500 to 3,000 feet, bound it respectively on the north and south, though a small portion of Harlan County extends over the Pine Mountain and adjoins Leslie, Perry and Bell counties. Harlan, the county seat, with elevations ranging from 1,178 to 1,197 feet is situated in the Upper Cumberland River lowlands at the juncture of Martins Fork and Clover Fork. Big Black Mountain somewhat to the east rising to an elevation of 4,150 feet on the heads of Clover Fork and Poor Fork is the highest elevation in the State of Kentucky. The minimum elevation—1,100 feet—is found in this county on the main waters of North Fork of the Cumberland shortly below Molus Station near the Bell County line.

The hard rocks of Harlan County consist of sandstones, sandstone conglomerates, shales and coals, principally of the Pottsville (Lower Pennsylvanian) series, though a few hill tops in the vicinity of Big Black Mountain carry restricted overlying outliers of the Allegheny series. The northern flank of Pine Mountain, an overthrust flexure of pronounced proportion, exhibits at one point or another limestones, sandstones and shales of the entire Mississippian and Upper Devonian systems. Alluviums of Recent age occur on the flood plains of the North Fork



STRUCTURAL SECTION THROUGH HARLAN COUNTY
The strike of this section is northwest and southeast at right angles to the general axis of the Middlesboro syncline, the Pine and the Cumberland mountains.

of the Cumberland River and its major tributary. The structure of Harlan County is synclinal, limbs of the pronounced Middlesboro trough being respectively the southeast flank of Pine Mountain and northwest flank of the Cumberland Mountain. The structural outline indicates a broad basin depression in the vicinity of Harlan from which the strata rise at very steep angles in the Pine and Cumberland Mountains on either side. The Pine Mountain overthrust fault is the largest structure of its kind in Kentucky, its displacement in this part of Harlan County amounting to from 4,500 to 5,000 feet. The overthrust or horizontal movement to the northwest involved in this great fault is estimated to have been several miles.

The principal mineral resource of Harlan County is bituminous coal, this occurring in about 12 to 15 seams of which the Imboden, Harlan, Kellioka (Keokee), Low Splint (Mason, Mingo and Jellico), Wallins (Dean, No. 4), and High Splint (Hind-

man) seams are of principal commercial importance at the present time. Some considerable cannel coal is also produced in this district. Harlan County is the chief coal producing county in Kentucky, having produced during 1925 11,766,359 tons. Sandstones suitable for rural building and bridge abutment purposes are quarried locally in Harlan County. Limestones suitable for highway construction and railroad ballast occur on the northwest flank of Pine Mountain. Clays adapted to common brick making occur as alluvial deposits in the bot-



LOG ROCK ON PINE MOUNTAIN IN HARLAN COUNTY.

toms of the North Fork of the Cumberland River. One or two drillings for oil and gas in this vicinity have resulted unsuccessfully.

A recently issued structural geological map of Harlan County based on the Fire Clay coal, scale 1 inch equals 1 mile, is available. This map gives detailed structural and stratigraphic section and locates all coal mines. The topography for this district is available on the Cornettsville, Hyden, Harlan, Nolansburg, Whitesburg, Hagan, Sneedsville, and Big Stone Gap sheets, scaled 1:62,500 or approximately one inch equals one mile.

XLIX.

HARRISON COUNTY.

Harrison County is located in the central northern Bluegrass region of Kentucky. It covers about 311 square miles, and is drained entirely by the North and South Forks of the Licking River. The county is undulating to hilly. Cynthiana, the



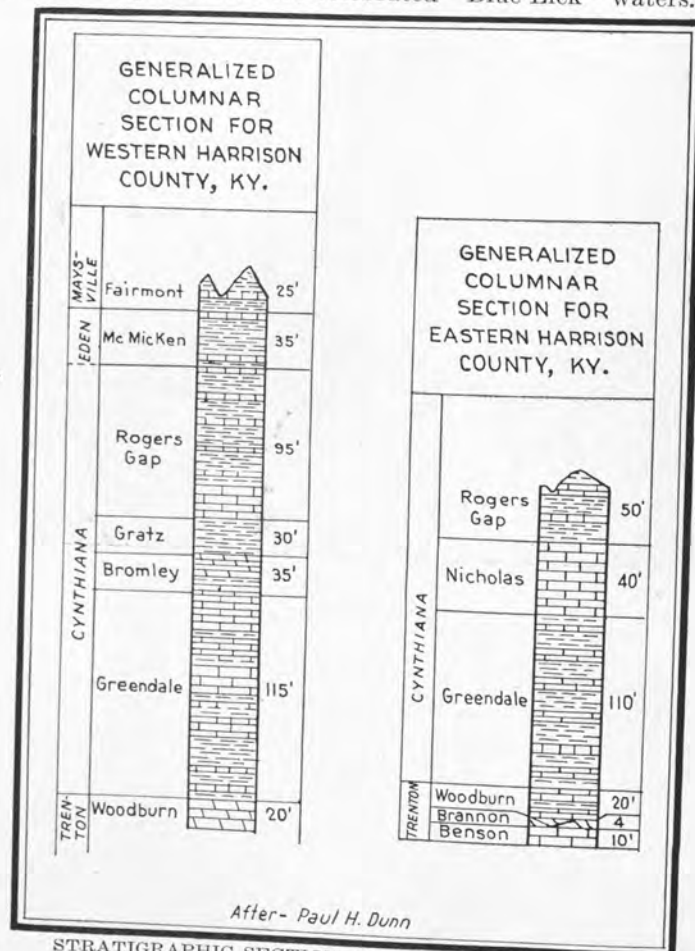
LIMESTONE QUARRY AT CYNTHIANA.

This is known as the J. R. Poindexter operation. Marbles have been sampled from some of the numerous quarries of Harrison County.

county seat, exhibiting an elevation of 700 feet in the valley of the South Fork is exceeded by low ridge elevations 200 to 250 feet higher on the Nicholas and Scott County lines.

The hard rocks of Harrison County consist of Ordovician limestones, calcareous shales, and shales ranging from the Cynthiana limestone up to the Maysville formation. The Eden shale is one of the prominent members of this group, and gives rise to a rather hilly maturely dissected type of topography where it comes to outcrop. The normal regional structure of Harrison County is a monocline tilted to the northeast due to the county's axial position on the Cincinnati Arch and on the north flank of the Lexington Dome. Major faulting is unknown in this district.

The principal mineral resource in Harrison County is limestone which occurs in adequate quantities for all necessary purposes for rural building, highway and railroad bed construction. Residual clays suitable for brick making are found in this district, and wells of reasonably shallow depths pierce the Trenton horizon and give rise to the celebrated "Blue Lick" waters.



STRATIGRAPHIC SECTION FOR HARRISON COUNTY

A new areal geological map of Harrison County scaled 1 inch equals 1 mile has recently been surveyed and is available. Topography has been executed for only a portion of this area—the Cynthiana Quadrangle which bears the date of 1929 and is scaled 1:62,500.

L.

HART COUNTY.

Hart County, drained by the Green and Nolin rivers, is located in south central Kentucky. It encompasses 406 square miles. For the most part it exhibits the rolling to hilly physical characteristic of the Pennyroyal district, but its north central area is pierced by a narrow eastward extension of the Pottsville



ANGULAR UNCONFORMITY ON NOLIN RIVER.
A pre-Pottsville fault, the only one definitely known in Kentucky, is indicated at this locality near Sims' Ford. It was found and described by the writer in 1928.

(basal) Coal Measures. Within this fingering belt of outcrop, physiographic and cultural conditions are similar to those found along the periphery of the Western Coal Field, of which it is in fact a part. Munfordville, the county seat, has an elevation of 571 feet, but ridge tops in the vicinity of Cub Run rise to 850 and 900 feet. A minimum elevation of 435 feet occurs at Dennison Ferry near the Edmonson County line on Green River.

The hard rocks of northern and southern Hart County consist of limestones, sandstones, and shales of the Chester (Upper Mississippian) series. The central northern part of the county—that territory immediately south, northeast, and southwest of Bonnieville—presents an areal pattern of semi-isolated outliers of sandstones, sandstone conglomerates, shales, and coals of Potts-

ville (Lower Pennsylvanian) age. The regional structure of Hart County is normally a geo-syncline, this area being located at the head of the eastern tip of the Western Kentucky Coal Basin. The Rough Creek disturbance crosses the main Nolin



CAVERNOUS CLIFFS ALONG GREEN RIVER.

The Mississippian limestone in Hart County close to the master stream exhibits many caves indicating former drainage debouchures into the old river ages ago. The tributary streams which produced these caverns have long since dropped to lower levels.

River and penetrates the northwestern part of the county, this fault passing eastward a few miles north of Priceville. Other pronounced faults parallel and cross transversely the area of Coal Measures south of Bonnieville.

The principal mineral resource of Hart County is limestone which is found in inexhaustible quantities widely distributed throughout the district. This stone is suitable for general

building, highway, and railway bed construction. Residual sands suitable for building purposes occur within and surrounding the outlier of the Coal Measures in the central northern part of the county. Northwest of Munfordsville a short distance, a thin coal, possibly of Chester age, is available for domestic operation. A number of wells drilled for oil and gas have secured



CLIFFS OF ASPHALT ROCK.

This exposure is on the water of Dog Creek in western Hart County. The ledge is a conglomerate of Pottsville age.

these minerals in small quantities. Small deposits of white kaolin are unworked. Subterranean scenery in the form of caverns, frequently of considerable size, is a natural resource asset of real value to the southern part of the county, particularly in the vicinity of Horse Cave.

An oil and gas map of Hart County, scale one inch equals one mile, is available. The topography west of the 86th Meridian has been recently executed to the scale of 1:62,500 and is available on the Mammoth Cave and Cub Run quadrangles.

LI.

HENDERSON COUNTY

Henderson County, drained by the Green and Ohio rivers and their tributaries, is located in the northern part of the Western Kentucky Coal Field. Areally it covers about 435 square miles. The terrain is a low lying rolling plateau. Henderson, the county seat, on the Ohio River has an elevation of 401 feet, but ridge elevations to the southeast and southwest rise to about 550 feet.

The hard rocks of Henderson County consist of Pennsylvanian sandstones, limestones and shales chiefly belonging to the Conemaugh division. Underlying rocks of Allegheny age outcrop in the eastern part of Henderson County. Large areas of alluviated lands are found in the creek and river bottoms, particularly in the northern part of the district. Henderson County occupies a structural position low in the Western Kentucky Coal Basin, the normal dip being to the northwest. The district is not faulted except along the Green River on the eastern border where the well defined Curdsville Fault strikes north-eastwardly for a few miles through the bottom lands adjacent to McLean County.

The principal mineral resource of Henderson County is bituminous coal which is produced for export from the following seams: No. 7, No. 9, and Nos. 12-14. All of these coals are of first commercial importance in this district. In 1925 the total volume of coal produced in Henderson County was 425,251 tons. Residual and transported clays suitable for brick and tile making are widely distributed in Henderson County. Sands and gravels suitable for general construction and road building purposes are produced from deposits in the Ohio River.

The geology of Henderson County has been executed both in map and report form. A structural geological map of the county issued in 1927 is available. The topography of this county is available on the Uniontown, Henderson, Newburg, Morganfield, Sebree and Calhoun quadrangles, scale 1:62,500, or approximately one inch to the mile.



OHIO RIVER BOTTOM LANDS. These rich alluvial plains are one of the great sources of wealth in Henderson County. During the Glacial Period they were covered with shallow Pleistocene river-pounded lakes. Some of these bottom lands are underlain by excellent coals.

LII.

HENRY COUNTY

Henry County is located in the northwestern part of the Outer Bluegrass Region of Kentucky. It encompasses 290.26 square miles. The district for the most part is an undulating upland plateau showing pronouncedly entrenched drainage along the Kentucky River and its major tributaries on the east. New Castle, the county seat, which is centrally located, has an elevation of 825 feet above sea level.



CONTORTED ORDOVICIAN LIMESTONE.

Between Monerey and Gratz there are a number of local crumplings such as this one close to the water level of the Kentucky River in Henry and Owen counties.

The hard rocks of Henry County consist of Ordovician limestones, sandstones and shales, principally of the Cincinnati group, though Upper Champlainian sediments appear in the main channel of the Kentucky River as far down stream as the vicinity of the mouth of Drennon Creek. Alluviums of Recent and Pleistocene age are found on the lowlands in the Kentucky River, throughout the eastern boundary of the county, but are most prominently in evidence below Gratz. Structurally, Henry County is on the northwestern flank of the Lexington Dome of the Cincinnati Arch and exhibits a monoclinial dip to the northwest. This tilted platform is flexed at a number of points by

anticlines and synclines of rather minor significance, and is traversed by a few faults of small throw.

The principal mineral resource of Henry County is limestone which may be produced in very large quantities suitable for rural building, highway construction, and railroad ballast. Sands of good quality and inexhaustible quantity are produced from the Kentucky River, and mineral waters of considerable range and value occur at a number of points, the most notable of which is Drennon Springs in the northern part of the county. Clays suitable for brick making are available. Barite and galenite occur in considerable quantities in the Lockport Vein. Sphalerite and calcite occur in lesser amounts.

A new geographic map of Henry County has been prepared during the passing year. An old reconnaissance map was published by the Second Geological Survey, but is now exhausted in edition. Topography along the eastern and western parts of Henry County is available on the Lockport and LaGrange quadrangles, scale 1:62,500. The Pleasureville Sheet is now in progress of field survey and will be ready for distribution in preliminary form early in 1929.

LIII.

HICKMAN COUNTY

Hickman County is located in western Kentucky adjacent to the Mississippi River. Typical in all respects of the Jackson Purchase Region, it has no through flowing streams of large importance but is drained by Obion Creek and Bayou de Chien. It

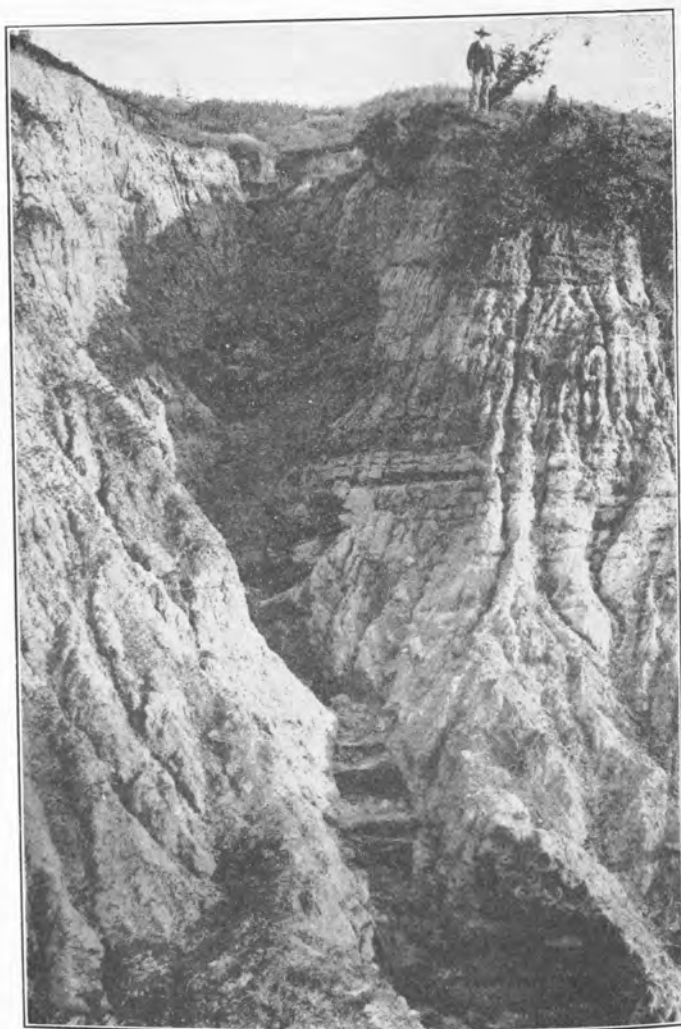


UNDULATORY TOPOGRAPHY NEAR CLINTON.

Much of the surface of Hickman County somewhat to the east of the Mississippi River is a broad sweeping plain.

covers about 225 square miles. The county is easily divisible on a physical basis into two units, the eastern or upland plateau, on which Clinton, the county seat, is located with an elevation of 391 feet, and the western lowlands, the Mississippi River bottoms including Wolf Island, which exhibit elevations ranging from 295 to 315 feet and are interspersed with many swamps and marshes. Low water in the Mississippi is 260 to 270 feet. A pronounced escarpment facing and paralleling somewhat the Mississippi River just east of Columbus attains summit elevations of 470 feet.

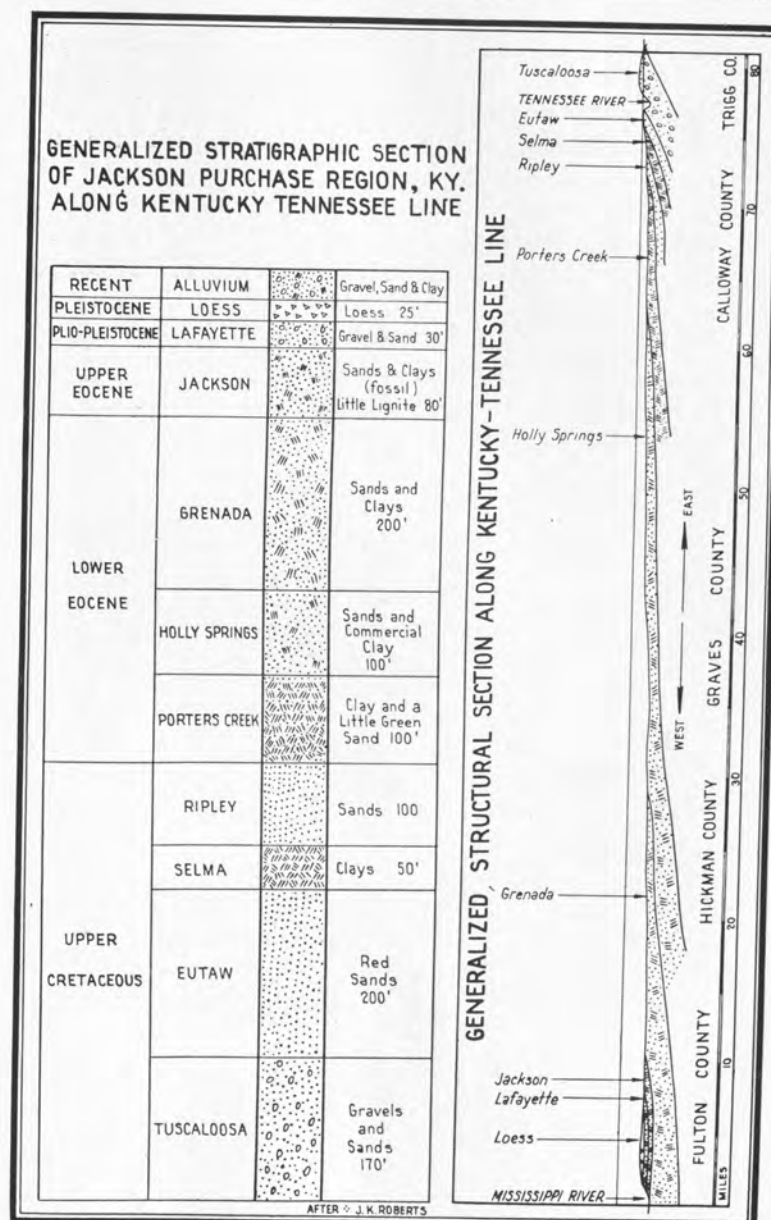
There are no hard rocks in Hickman County, all of the sediments being unconsolidated sands, gravels and clays of Tertiary age with exception of the alluviums on the lowlands of the Mississippi River which are of Pleistocene and Recent deposition. The oldest sediments are the LaGrange sands (Eocene) above



ERODING TERTIARY BLUFFS NEAR COLUMBUS

While this escarpment is rapidly receding the silt carried to the plain below has been insufficient to raise it above extreme flood levels of the Mississippi. For this reason the most of the town of Columbus, Kentucky, was removed recently to higher levels.

which appear LaFayette (Pliocene) sands and gravels. The western portion of the uplands of Hickman County averaging about 375 feet in height are covered with a fine loess of Pleistocene age. The surface does not reveal the detailed structure of



STRATIGRAPHIC AND STRUCTURAL SECTIONS FOR THE JACKSON PURCHASE REGION.

Hickman County which can only be inferred to be a monocline strongly tilted to the southwest. The Paleozoic platform and possibly the superimposed Mesozoic beds underlying this county are thought to be considerably faulted in keeping with the fault pattern surrounding the Western Embayment Region of Kentucky.

The principal mineral resources of Hickman County are clays and gravels, the former being useful for ordinary brick making purposes and the latter for road building. Slightly mineralized water is obtained from drilled wells.

A geographic map of Hickman County is available, scale one inch equals one mile. The county outline has been presented on a small scale geological map of the Jackson Purchase, prepared and issued by the Second Geological Survey of Kentucky in 1885.

LIV.

HOPKINS COUNTY

Hopkins County is situated in the southwestern part of the Western Kentucky Coal Field. It encompasses about 546 square miles. The region is one of low rounded hills interspersed by broad flat alluviated creek and river valleys. Madisonville, the county seat, has an elevation of 470 feet, but eleva-



AN IMPORTANT HOPKINS COUNTY MINE.

This coal operation known as the North Diamond Mine is located about one and one-half miles north of Earlington. It operates the No. 9 coal at 186 feet and has through use of a modern steel and concrete tippie a capacity of 3,500 tons a day. It was opened in 1922.

tions of some ridges in the county rise to approximately 650 and 700 feet. The district is drained by the Tradewater River, a northwest flowing tributary of the Ohio, and the Pond River, a tributary of Green River.

The hard rocks of Hopkins County consist of limestones, sandstones, shales and some sandstone conglomerates, all of Pennsylvanian age, ranging from middle Lower Pottsville up through the Allegheny and well into the upper part of the Cone-maugh series. The valley bottoms are filled with alluviums, sands, clays and silts of Pleistocene and Recent age to depths ranging up to and well over 100 feet in some instances. The broad structural pattern of Hopkins County exhibits a number of faults striking somewhat north of east. It is a monocline tilted to the northeast into the trough of the Western Ken-

tucky Geo-syncline. Because of this tilting, Pottsville formations are found in the southwestern portions of the county adjoining Christian and Caldwell counties, while the Conemaugh,



LOW ROUNDED HILLS AND BROAD FILLED VALLEYS.
This type of topography is typical of many parts of Hopkins and other Western Coal Field counties.

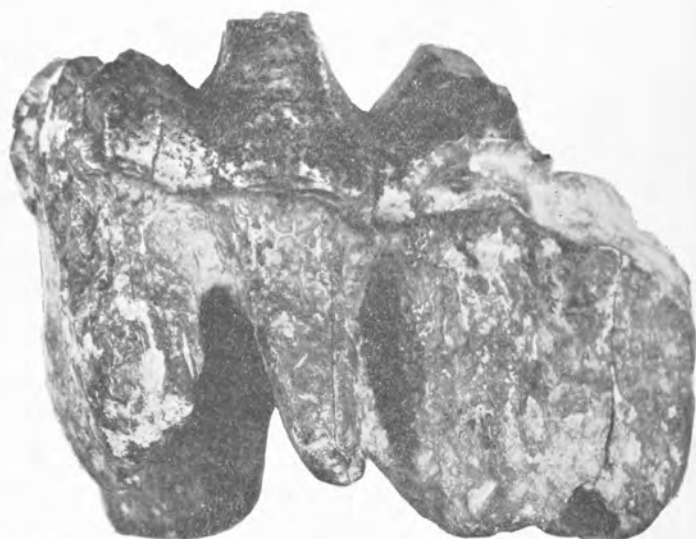
or highest Pennsylvanian formations, occurs in the eastern part of the county adjoining McLean and Webster counties. In detail the pattern of local faulting is something in the nature of mosaic, only the principal lines of which have been worked due to its great complexity and the presence of a thick series of Coal Measure shales which weather to soft residual clays and serve to blanket many geological criteria in the field.

The principal mineral resource of Hopkins County is bituminous coal. Production in 1925 amounted to 3,857,101 tons. The seams of principal importance are the following: Nos. 9, 11, 12, and 14. Of these coals No. 9 and No. 11 afford the largest number of major commercial mining operations. Residual and transported clays suitable for brick making are available. Outcrops of low grade bituminous sandstone of Coal Measure age in the southern part of Hopkins County have been proposed as "rock asphalt" for use as road surfacing material, but their quality and quantity is not determined. Oil and gas in commercial quantities have been secured in the vicinity of Morton's Gap.

A detailed geological map of Hopkins County, scale one inch equals one mile, is available. The topography of this district has been executed and may be reviewed on the Providence, Princeton, Earlington, Madisonville and Dawson Springs, and Nortonville quadrangles, scaled 1:62,500, and presented with a contour interval of 20 feet.



A STRIPPING COAL MINE.
Hopkins County has several of these daylight coal mines. Though much overburden must be moved a very high percentage of coal recovery is possible with good working conditions.



MASTODON TOOTH FROM THE HEADWATERS OF THE WAR FORK.

LV.

JACKSON COUNTY

Jackson County is situated in the western central portion of the Eastern Kentucky Coal Field. It covers an area of 346.37 square miles and is drained by the South Fork of the Rockcastle River, and Station Camp and Sturgeon creeks of the Kentucky River. The county is a maturely dissected plateau of low relief. The southern part of the county exhibits narrow meandering



UPLANDS IN NORTHERN JACKSON COUNTY.

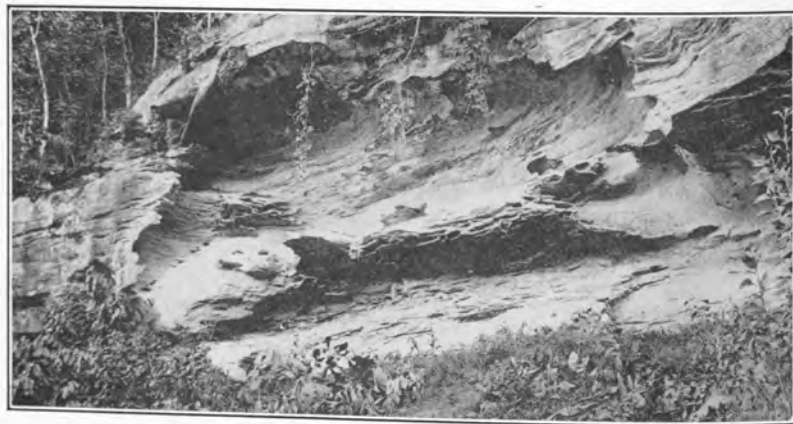
The surface is a thin veneer of Coal Measure sandstone and shales under which are found the well known Mississippian limestones.

creek bottoms with steeply forested slopes, while in the northern part of this district narrow meandering valleys are flanked by steep slopes capped by precipitous walls of limestones and sandstones. McKee, the county seat, with an elevation of 976 feet is representative of the uplands separating the Kentucky River from the Cumberland River drainage.

The hard rocks of Jackson County consist of Mississippian and Pennsylvanian limestones, sandstones, sandstone conglomerates, shales, and coals. The Mississippian outcrop is confined to the creek bottoms and medial slopes in the northwestern part of the county. The southeastern part of the county as well as the ridges throughout this district are entirely covered with Coal Measure formations. The structural geology of Jackson County is in essence a southeastward dipping monocline flexed through-

out by a number of southeastward plunging anticlines and synclines. The county has no major faults of record.

The principal mineral resource of Jackson County is bituminous coal, production being confined at the present time entirely to domestic use. Oil and gas have been indexed in a number of wells, but are only produced in commercial quantities in the northern part of the county on the South Fork of Station Camp Creek. The "Corniferous sand" largely productive in Lee, Estill and Owsley counties adjoining on the northeast and



RESULTS OF WIND AND FROST ACTION.

Many of the Pottsville sandstones have an irregular distribution of ferruginous cement. After continued exposure in a cliff side a spotted and honeycomb effect is produced such as that seen above.

east, underlies Jackson County at similar drilling depths in rather favorable structural positions. Limestones suitable for road building and rural building construction occur in the northwestern part of Jackson County.

A detailed oil and gas geological map of Jackson County produced in 1927 to the scale of one inch equals one mile is available. The topography of this county is available on the Richmond, London, Manchester and Beattyville quadrangles, scale 1:125,000.

LVI.

JEFFERSON COUNTY

Jefferson County is situated in central northern Kentucky adjacent to the Ohio River and the State of Indiana. It is drained principally by Pond and Beargrass Creeks, and Floyd's Fork of the Salt River. Although the most populous county in



OHIO RIVER FALLS POWER HOUSE.

This great hydroelectric plant has recently been put in operation at Shippingport by the Louisville Hydroelectric Co.

the State, it covers only 387 square miles. Louisville, the metropolis of Kentucky and county seat of Jefferson County, situated on the Ohio River flood plain, has an elevation ranging from 463 feet to 590 feet. It is surpassed in elevation by a rolling to hilly topography to the east and south ranging up to 765 feet near the headwaters of Cane Run, and 875 feet near South Park. Jefferson County has been colloquially described as situated in the "Beargrass" but in reality it comprises parts of three separate physiographic regions. The eastern part of the county exhibits in the vicinity of Fisherville a part of the Outer Bluegrass. Throughout the central and southern portion of this

district one finds excellent exemplifications of the Knobs Belt of which this portion is actually a unit. Along the entire western border particularly in the southwest the Ohio River lowlands are conspicuously dominant.

The hard rocks of Jefferson County range from Upper Ordovician limestones and shales, which in passing it may be noted are conspicuously in outcrop in the vicinity of the Falls of the Ohio River, up through the lower Middle Mississippian which is



OHIO RIVER BOTTOMS NEAR LOUISVILLE.

The view shows old log house and barns on the Norton ranch nine miles south of the city, in Jefferson County. Ditching has been done at various points in these flat lands to increase their agricultural productivity.

to be found only in the southwestern part of the county. Sands, gravels, clays and silts existing as Pleistocene and Recent river deposits constitute the western lowlands of Jefferson County. Reworked fluviatile glacial deposits are much in evidence in this part of the district, which includes the site of Louisville. The structural geology of Jefferson County as indicated by its geographic position low down on the western flank of the Cincinnati Arch, is that of a monocline tilted to the west unfaulted in a major way.

The most important mineral resources of Jefferson County consist of limestones, shales, clays, sands and gravels. Limestones of Ordovician, Silurian and Devonian age occur widely distributed in the eastern and central part of the county. They are useful for all general purposes of rural as well as urban building, bridge, highway and railroad construction. Sands occur as alluviated deposits within the county and are dredged

from an inexhaustible supply in the Ohio River. Fluvial gravels are also widely used for general constructional purposes. Throughout the outcrop of the Devonian shales there are many highly mineralized springs and some wells drilled to these formations are used in a commercial way. Clays and shales of alluvial as well as residual character are used in brick and tile manufacture in Jefferson County. A large latent unit of

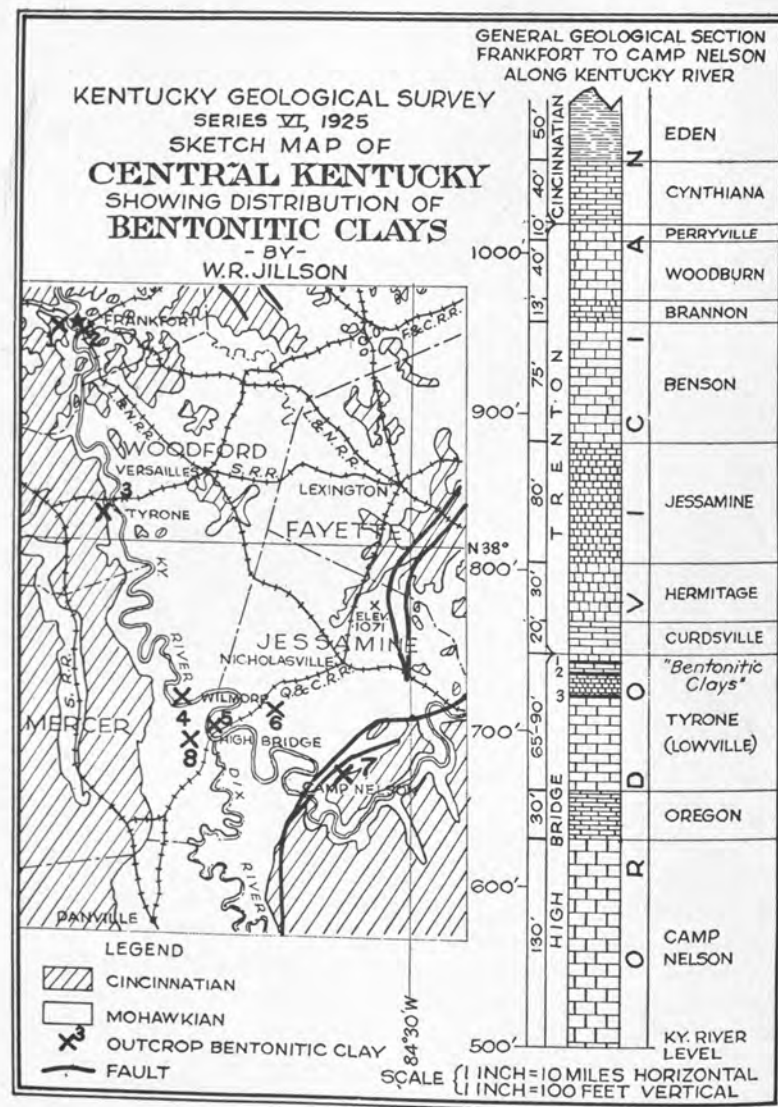


SOUTH PARK LAKE.

Kentucky has no natural lakes entirely within its boundary but the State has a number like this one made by man in Jefferson County.

hydro-electric power is now being brought into control by damming the Ohio River immediately below the Falls at Louisville.

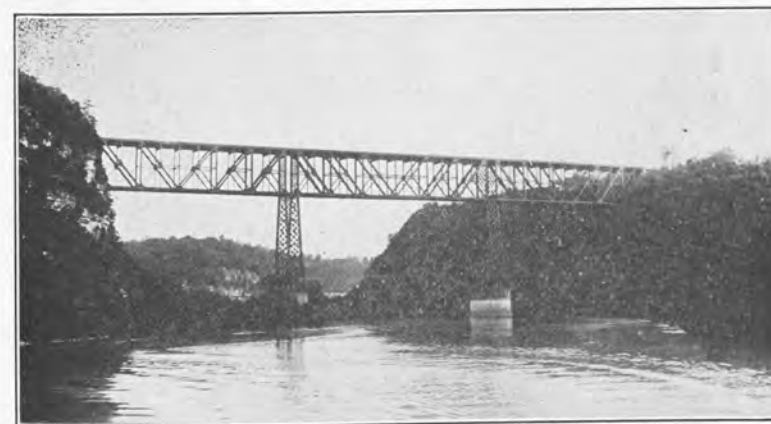
A detailed geological report on this area supported by an excellent geological map was published in 1915 by the Kentucky Geological Survey but is now out of print. A fine topographical map of Jefferson County is available at the scale of 1:62,500, or approximately one inch equals one mile. The topography of Jefferson County is also presented in separate regional sheets on the Kosmosdale, Louisville, Taylorsville, Prospect, and La-Grange quadrangles, scale 1:62,500.



LVII.

JESSAMINE COUNTY

Jessamine County is situated in the Inner Bluegrass Region of Kentucky. It encompasses only 172 square miles. The terrain of this county is that of an undulating upland which exhibits many elevations ranging between 900 and 1000 feet. Hickman and Jessamine creeks, south flowing tributaries of the Ken-

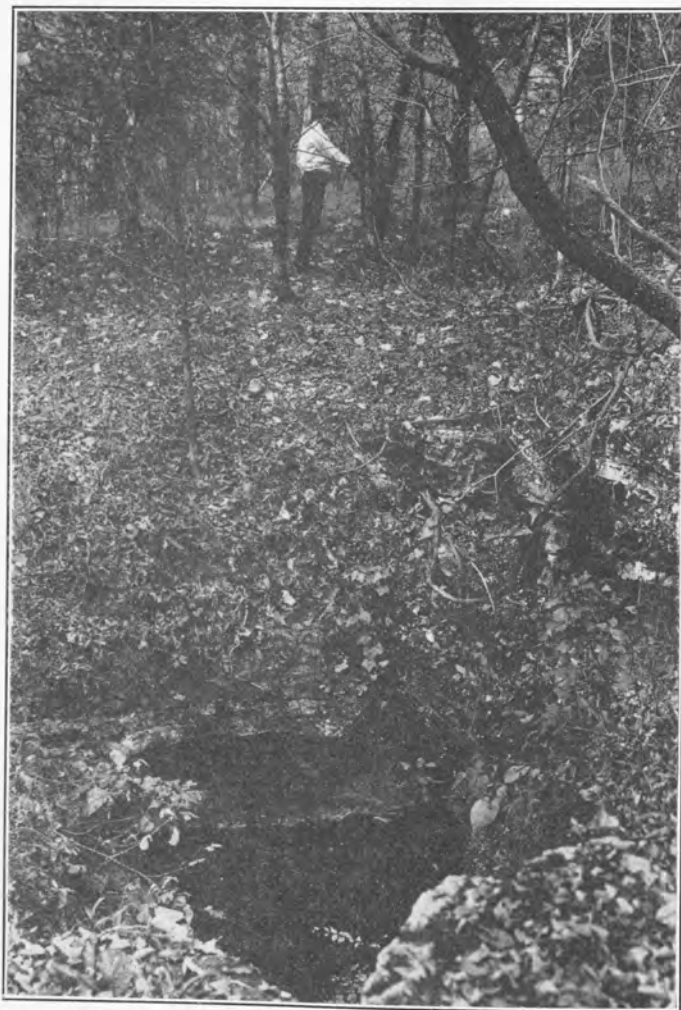


HIGH BRIDGE OVER THE KENTUCKY RIVER.

This railroad span of steel and stone connecting southern Jessamine with Mercer county is 308 feet above the ordinary level of the river.

tucky River, constitute with the latter stream the principal lines of drainage. Thick soluble limestones coupled with deep entrenchment has given rise to a pronouncedly Karst or sinkhole topography along the lines of major drainage. Nicholasville, the county seat, has an elevation of 948 feet while one of the highest elevations in the Inner Bluegrass—1071 feet—is found near Brannon Station. The lowest elevation of the county, about 495 feet, is near the Woodford County line on the Kentucky River.

The hard rocks of Jessamine County consist of Ordovician limestones and shales, principally of the Champlainian (Mohawkian) division of the Ordovician series. Some representatives of the Lower Cincinnatian group are found in the northern

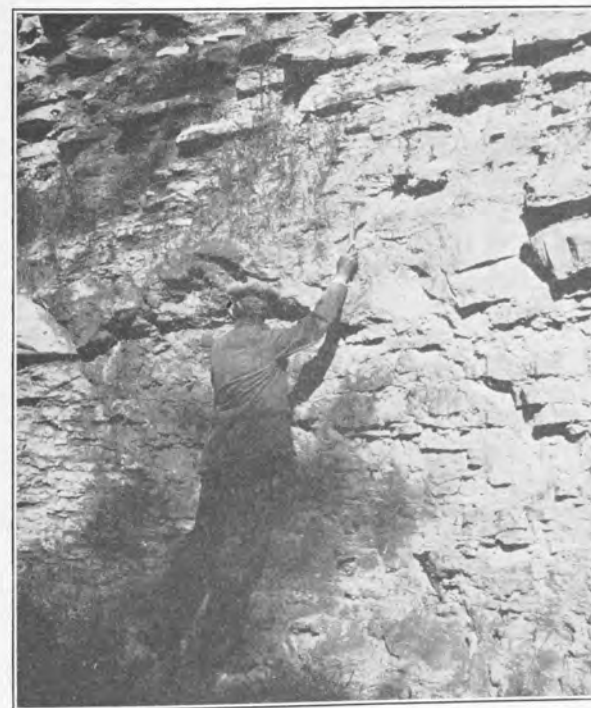


ONE OF JESSAMINE'S MANY SINK HOLES.

Due to considerable elevation above the Kentucky River the rather pure Ordovician limestones of this part of the Bluegrass Region are broadly honeycombed with underground drainage channels. Caves and sinks abound.

part of the county on ridges adjacent to the Fayette County line. A somewhat rectangular unit of this same group is found in the great bend of the Kentucky River in the southeastern part of the county. Structurally, Jessamine County occupies a

crestal position on the Lexington Dome of the Cincinnati Arch, and is traversed by the West Hickman and the Kentucky River normal faults which join tangentially just northeast of the little hamlet of Ambrose. Each of these faults exhibits displacements of considerable proportions.

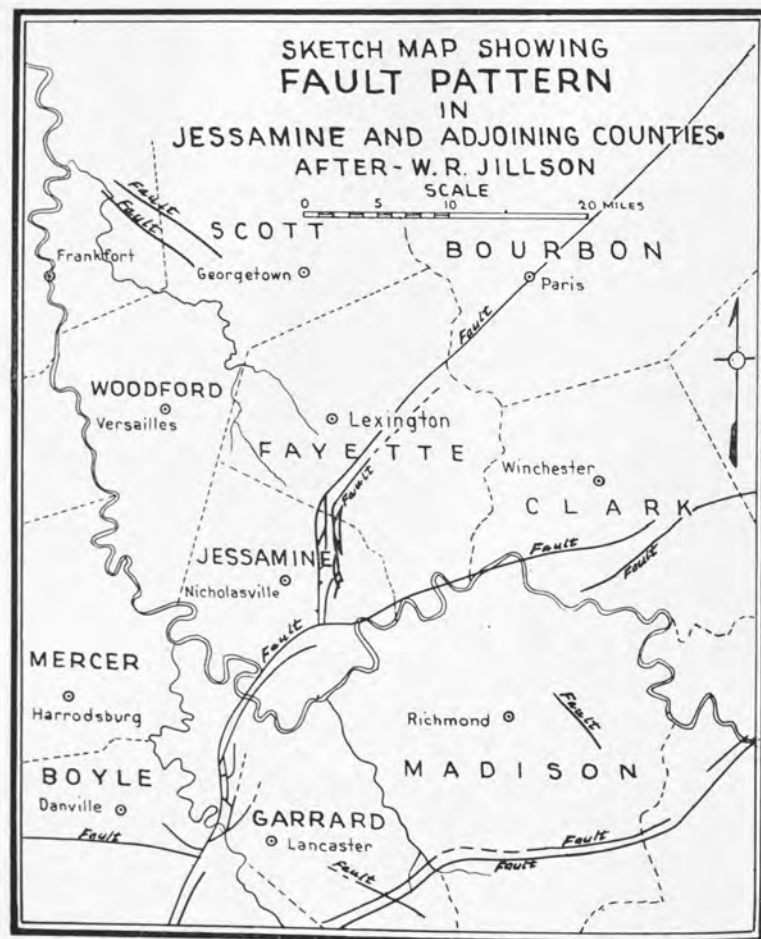


BRANNON LIMESTONE TYPE LOCALITY.

In this view E. O. Ulrich is indicating the contact of the Brannon with the underlying Bigby limestone about one mile south of Brannon Station on the Southern Railroad in Jessamine County.

The principal mineral resource of Jessamine County is limestone which is present in inexhaustible quantities suitable for rural and urban building construction as well as highway use and for railroad ballast. Good grades of commercial agricultural limestones occur in this county. Residual clays suitable for brick making are present and sands useful for general construction purposes may be dredged through the Kentucky River channel. A blue-green galuconitic shale having the characteristic

of a bentonite occurs at the top of the Tyrone limestone in the vicinity of High Bridge and elsewhere.



PORTION OF CENTRAL KENTUCKY FAULT PATTERN.

A new reconnaissance geological map of Jessamine County is available, and the topography, scale 1:125,000 or approximately one inch equals two miles, has been executed on the Richmond and Harrodsburg sheets.

LVIII.

JOHNSON COUNTY

Johnson County is located in the central portion of the Eastern Kentucky Coal Field and is typically a low altitude "Mountain" county. Areally it contains about 268 square miles. It is drained by the Levisa Fork of the Big Sandy and its local tributaries, the most important of which are Paint, Jenny, Greasy, Miller's, and Blain creeks. The physical aspect of the countryside is that of a maturely dissected plateau. Entrenched meandering drainage exhibiting restricted bottoms encompassed by usually steep forest covered winding ridges of low relief is characteristic of this region. The middle waters of Paint Creek trenced deeply into the erosion resisting Pottsville conglomerate where the formation is brought to the surface by the Paint Creek Uplift, are actually gorged and present a truly precipitous relief.

Paintsville, the county seat, located on the flood plain of Paint Creek near its juncture with the Big Sandy River has elevations ranging from 610 to 635 feet, but ridges to the south and southeast attain elevations rising variously up to 1200 and 1400 feet. The lowest elevation—600 feet—is found at the mouth of Creek Uplif, are actually gorged and present a trully precipitous relief.

The hard rocks of Johnson County consist of Coal Measure sandstones, sandstone conglomerates, shales, coals and one or two very thin bedded and undependable limestones, and calcareous shales. These rocks belong principally to the Pottsville formation but Allegheny representatives occur as outliers high in some of the ridges in the eastern part of the county. Structurally the county is bisected along a generally east and west line by the Irvine-Paint Creek Fault which exhibits a varying displacement ranging usually from 80 feet to 150 feet. The normal structural position of the county is that of a southeastward tilted monocline located toward the bottom of the Eastern Kentucky Geo-syncline. The monocline is flexed throughout by minor synclines and anticlines some of which culminate in

domes. The western portion of Johnson County overrides the prominent Paint Creek Uplift, the most pronounced north-south anticlinal and doming structure of Eastern Kentucky.

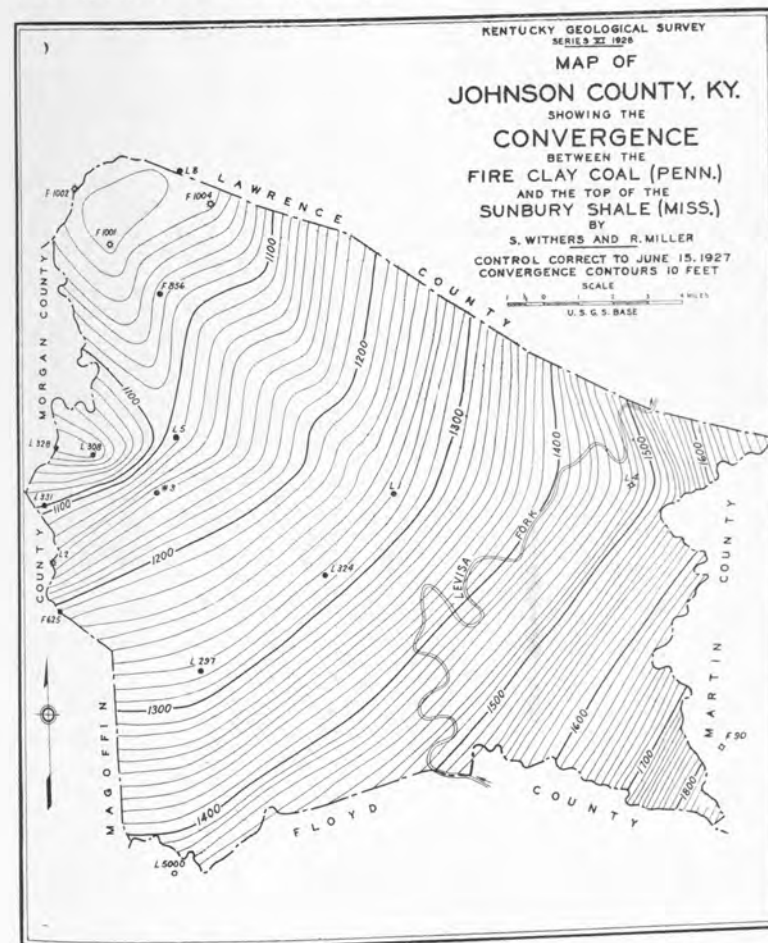


IN THE GORGE OF PAINT CREEK.

The cliffs at the right are Pottsville conglomerate sandstones, elevated by regional uplift and trenched by creek waters.

The most important mineral resources of Johnson County are coal, oil and gas. The coal is principally of bituminous grade, although a number of cannels are reported, some having been operated. In 1925 the coal output of Johnson County was 1,173,040 tons, principally produced from the Vanlear or Miller's Creek seam. Petroleum in commercial quantities and excellent quality occurs in the Wier (Cuyhoga-Mississippian) sand in the western and northwestern parts of Johnson County; while gas is produced from this sandstone, and also to a lesser extent from the underlying Berea (Mississippian) and still lower Corniferous (Lower Devonian) limestone. Small amounts of petroleum in widely scattered wells indicate the possibility of producing oil from the Berea in the central and southeastern parts of Johnson County. Sandstones suitable for rural and urban building construction, bridge abutments, highway and railroad bed work are present in large quantities. Mineral springs of small volume and some minor deposits of galena, sphalerite and calcite are rec-

ognized along the Paint Creek Fault. Asphaltic sandstones in the Pottsville conglomerate occur in western Johnson County on the upper waters of Paint Creek and some of its tributaries, but are not sufficiently rich or thick enough, it is thought, to be of value for road-building purposes.



CARBONIFEROUS CONVERGENCE IN JOHNSON COUNTY

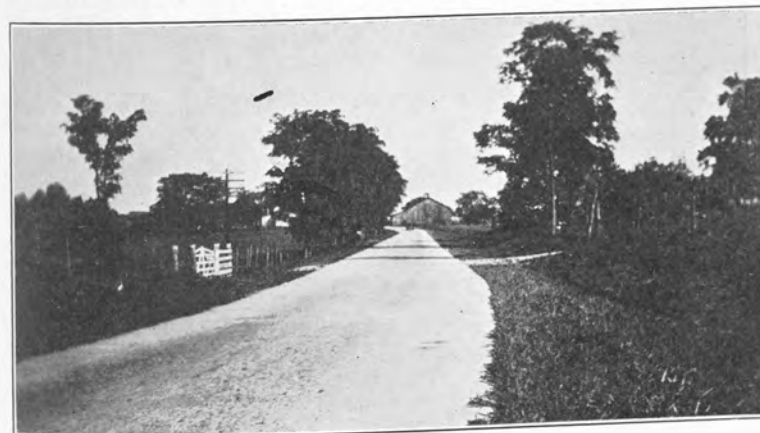
A geological oil and gas structural map of Johnson County of date 1921, keyed on the Fire Clay coal and presented at the scale of one inch equals one mile is available. The subsurface

structure of this county has been drawn in manuscript on the Sunbury shale, and will shortly be published. The topography of Johnson County is available on the Salyersville Sheet, scale 1:125,000, and the Paintsville, Inez and Prestonsburg quadrangles, scale 1:62,500.

LIX.

KENTON COUNTY

Kenton County is situated in northern Kentucky adjacent to the Ohio River and the State of Ohio. It contains about 163 square miles, is embraced within the Outer Bluegrass Region and is hilly throughout. Covington, the county seat, situated on the



RIDGE TOPOGRAPHY IN KENTON.

The view is four miles south of Independence on the Covington-Falmouth Highway. Good roads penetrate all parts of Northern Kentucky.

Ohio River flood plain at the mouth of the Licking River, has an elevation of 514 feet, while the upland to the south particularly in the vicinity of Bracht rises to about 920 feet. Bank Lick, Cruises, and Grassy creeks, flowing eastwardly into the Licking River, drain the greater part of the county.

The hard rocks of Kenton County consist of Upper Ordovician limestones, sandstones and shales, all encompassed within the Cincinnati group. The structural position is low on the northern flank of the Lexington Dome of the Cincinnati Arch. Its structural attitude is that of a northerly dipping monoclinial platform flexed into low angle anticlines and synclines at a number of points, but unfaulted so far as is known.

The principal mineral resource of Kenton County is limestone which is available in inexhaustible quantities for general

rural building, highway and railroad bed construction. Sands suitable for construction purposes may be secured from both the Licking and Ohio rivers. Gravels for similar purposes may be secured from the Ohio River. Mineral waters similar to those



VALLEY TOPOGRAPHY IN KENTON.
The view is six miles south of Covington on the new Falmouth pike.

produced at Big Bone Lick and Blue Lick may be secured here in drilled wells of medium depth.

A géographic map of Kenton County combined with Campbell, dated 1923, scale one inch equals one mile, is available. The topography for this county has also been executed, scale 1:62,500, on the Cincinnati "double" Sheet.

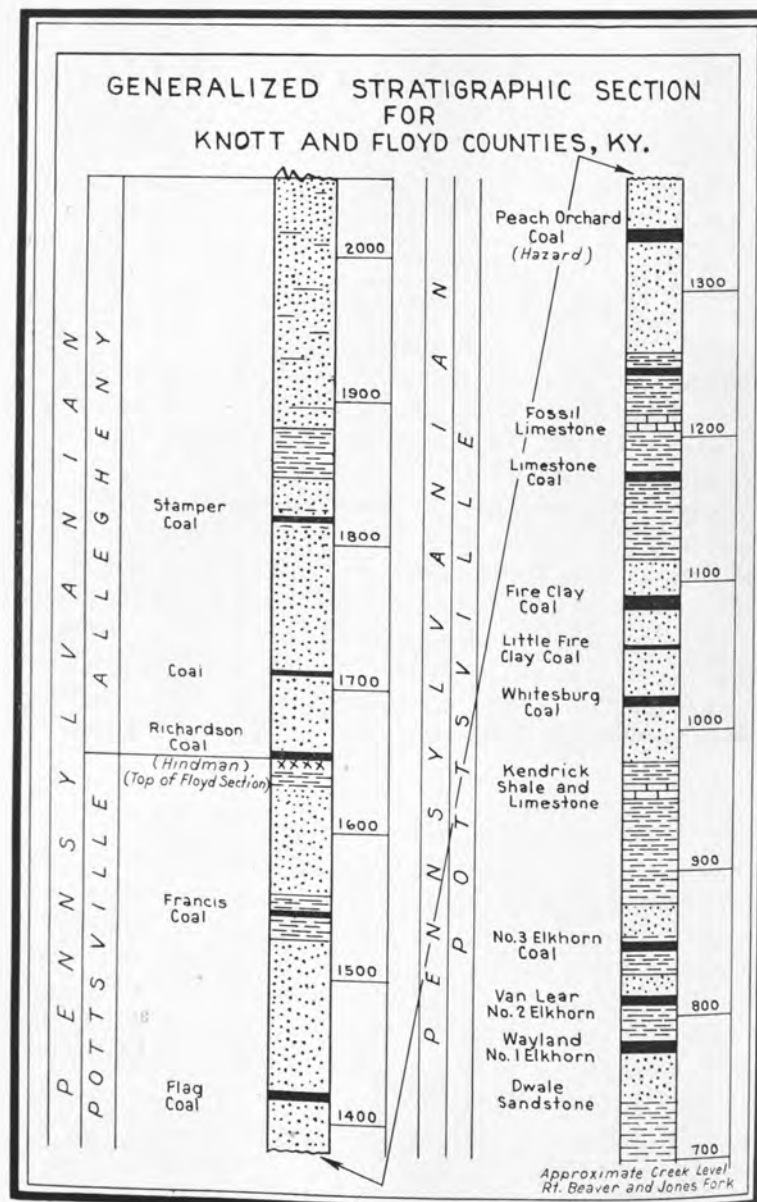
LX. KNOTT COUNTY

Knott County is situated in the southern central part of the Eastern Kentucky Coal Field. It encompasses 348 square miles. This district is typical of the Mountain Region of southeastern Kentucky. It is drained by the Quicksand and Troublesome creeks and Carr's Fork of the Kentucky River, and Right Beaver Creek of the Levisa Fork of Big Sandy River. The county is a typical headwaters unit in the maturely dissected Cumberland Plateau. Hindman, the county seat, with an elevation of 1032 feet on the upper waters of Troublesome Creek is surpassed by many ridges to the southeast which rise to elevations varying from 1800 to 2200 feet above sea level.

The rocks of Knott County consist of Pennsylvanian sandstones, sandy shales and coals with an occasional thin limestone. These sediments are all of Pottsville age with the exception of some outliers of the Allegheny which are found high on the hills of a few ridges in the northern part of the county. Creek bottom alluviums are all of Recent age. Structurally Knott County is a monocline dipping to the northwest into the Eastern Kentucky Geo-syncline which traverses the adjoining counties of Perry, Breathitt, Magoffin, and Floyd. The county exhibits no faults of major significance.

The most important mineral resources of Knott County are bituminous coal, petroleum and natural gas. In a sequence of about ten seams are the following coals of commercial importance in Knott County: the Fire Clay, the Hazard, the Flag, and the Hindman. Oil and gas are secured in commercial quantities in the Horton and Beaver sands, (Pottsville-Pennsylvanian) and in the underlying Maxon sand (Mauch Chunk-Mississippian). Further production may be secured from deeper sands, including the Chattanooga (Devonian) black shale.

A structural oil and gas map of Knott County produced in 1919 to the scale of one inch equals one mile, is available. The topography has been executed on the Salyersville Sheet, scale 1:125,000, and on the Troublesome, Hindman, Pikeville, Whitesburg, and Cornettsville quadrangles, scale 1:62,500.



LXI.

KNOX COUNTY.

Knox County is situated in the southeastern part of the Eastern Kentucky Coal Field. It contains about 356 square miles. This county is drained by the North Fork of the Cumberland River and its local tributaries, the largest of which are Brushy, Stinking, and Richland creeks. It exhibits a maturely



CUMBERLAND RIVER BELOW BARBOURVILLE.

The view is from "Long Hill" and shows the master stream of southeastern Kentucky at low water.

dissected dendritic drainage pattern. Barbourville, the county seat, situated in a broad meander of the Cumberland, with an elevation of 975 feet, is surrounded by a maze of winding forested ridges which rise, particularly in the southern and eastern parts of the county, up to 2,000 feet. The valley bottoms are narrow, meandering. Along and close to the Cumberland River these "Mountain" lowlands are considerably alluviated.

The hard rocks of Knox County consist principally of sandstones, sandstone conglomerates, shales and coals of the Pottsville formation. Fluvialite sands, clays, and gravels are of Recent age. The surface structure of Knox County is that of a great trough due to the fact that the Eastern Kentucky Geosyncline strikes north-eastwardly across the entire district. The

sub-surface (Mississippian) structure of Knox County is monoclinical, the inclination being sharply to the southeast.

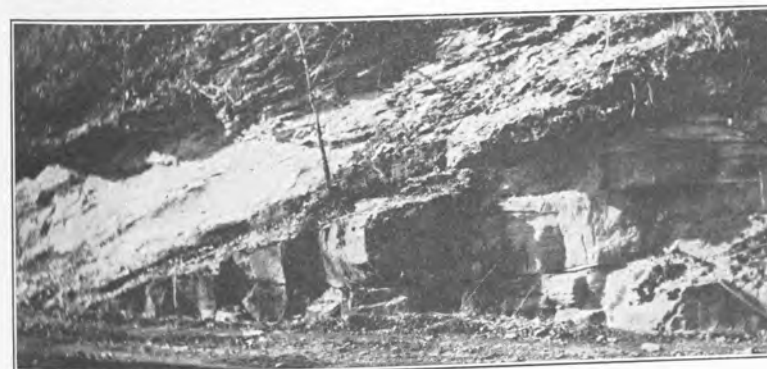
The most important mineral resource of Knox County is bituminous coal, but a considerable amount of cannel coal is present. The principal coal seams in Knox County are the following: Straight Creek, Blue Gem, Jellico, Dean or No. 4. From these in 1925, 368,026 tons were produced. Oil and gas in commercial quantities have been produced from Knox County for many years, the oil chiefly coming from the three Coal Measure sands (1) "Wages," (2) "Jones" and (3) "Epperson." Natural gas is secured from these formations and from the underlying "Big Lime" and "Big Injun" sands (Mississippian). Residual clays and clay shales suitable for brick making occur, and some transported clays along the Cumberland River might also be used for this purpose.

A map showing the oil and gas structural geology of Knox County, dated 1925, keyed on the Fire Clay coal is available, scale one inch equals one mile. Reconnaissance topography is presented on the Manchester, Williamsburg, and Cumberland Gap quadrangles, scaled 1:125,000.

LXII.

LARUE COUNTY.

Larue County is situated in central Kentucky in the north-eastern part of the Pennyroyal district. It covers about 288 square miles and for the most part is a rolling to hilly upland plain tilted to the southwest. It is principally drained by the headwaters of Nolin River. The eastern part of the county is maturely dissected by local tributaries of the Rolling Fork of



IRREGULAR MISSISSIPPIAN SEDIMENTATION.
This outcrop occurs on the New Haven-Hodgenville Pike in Larue County. It has frequently been mistaken by casual observers for anticlinal structure.

Salt River. Hodgenville, the county seat, with an elevation of 700 feet, is representative of the plateau, while Lyons and other points along the Rolling Fork of Salt River at the base of the northeast facing scarp known as Muldraugh's Hill, have elevations of about 450 feet.

The hard rocks of Larue County consist of a series of Middle Paleozoic sediments ranging from Silurian upward through the Devonian and lower Middle Mississippian limestones, sandstones and shales. Alluviated sediments in the valley of Rolling Fork are of Pleistocene and Recent age. Structurally the county is a westward tilted monocline somewhat flexed on low angles but unfaulted so far as is known along major lines.

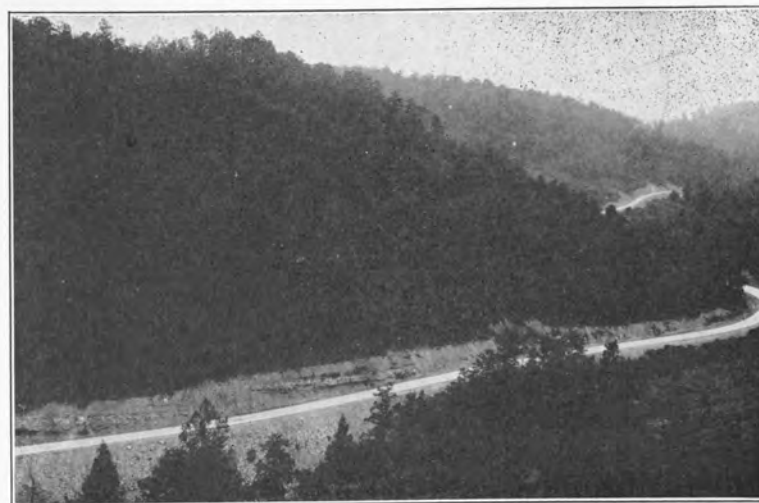
The principal mineral resource of Larue County is limestone, which is available for rural and urban building construction in large quantities. These limestones may also be used for highway and railroad bed construction purposes, and agricultural lime. Clays suitable for common brick-making are available as residual upland deposits. Black Chattanooga (Devonian) oil shales outcropping along the Larue County line in the valley of the Rolling Fork afford a large future source for the manufacture of artificial petroleum.

A geographic map, scale 1 inch to the mile, of Larue County, dated 1924, is available. The district is not surveyed topographically.

LXIII.

LAUREL COUNTY.

Laurel County is situated in the southwestern part of the Eastern Kentucky Coal Field. It is through a plateau exhibiting markedly uniform features. Areally it covers 442.16 square miles. London, the county seat, has an elevation of 1,250 feet. The central portion of this upland plain is studded with outly-



NEW MOUNTAIN ROAD IN LAUREL.

The rocks exposed belong to the Lower Coal Measures and the topography shown is typical of the deeply dissected portions of this part of Eastern Kentucky.

ing knobs, while in the eastern part of the county these merge into a maturely dissected entrenched drainage with narrow meandering valleys and winding forested ridges so characteristic of the "Mountains" of Eastern Kentucky. The western part of the county is clifted. The lowest elevation is found on the Rockcastle River at its juncture with the Cumberland River, and is approximately 675 feet.

The hard rocks of Laurel County consist of sandstone conglomerates, shales and coals, all of Pottsville (Pennsylvanian) age. Alluviums of Recent deposition occur along the narrow

flood plains of the major streams, particularly Rockcastle, Laurel and Cumberland rivers. Situated on the eastern flank of the Cincinnati Arch, the county is essentially a monocline tilted to the southeast. This normal surface structure is flexed by many local anticlines and synclines, the largest of which is the Rockcastle River Uplift. This fold, taking figure in the vicinity of Farriston on the Louisville and Nashville Railroad, strikes northeastwardly across Laurel County into Clay and Owsley counties. It is a doming anticlinal feature of major proportions. No faults of consequence are known to occur in Laurel County.

The principal mineral resource of Laurel County is bituminous coal, but some amounts of cannel coal have been produced. The exported coal tonnage of 1925 was 158,913. Oil and gas in considerable quantities have been uncovered in this county, but have never been considered of commercial importance. Sandstones suitable for rural building, highway and railroad bed construction are available in inexhaustible quantity. Residual clays might also be used for brick-making. Residual sands in occasional weathered deposits and transported fluvial sands along the Rockcastle and Laurel rivers afford inexhaustible supplies of sand for general construction purposes. Mineral springs of recognized therapeutic value occur on the lower waters of the Rockcastle River, and were formerly much patronized.

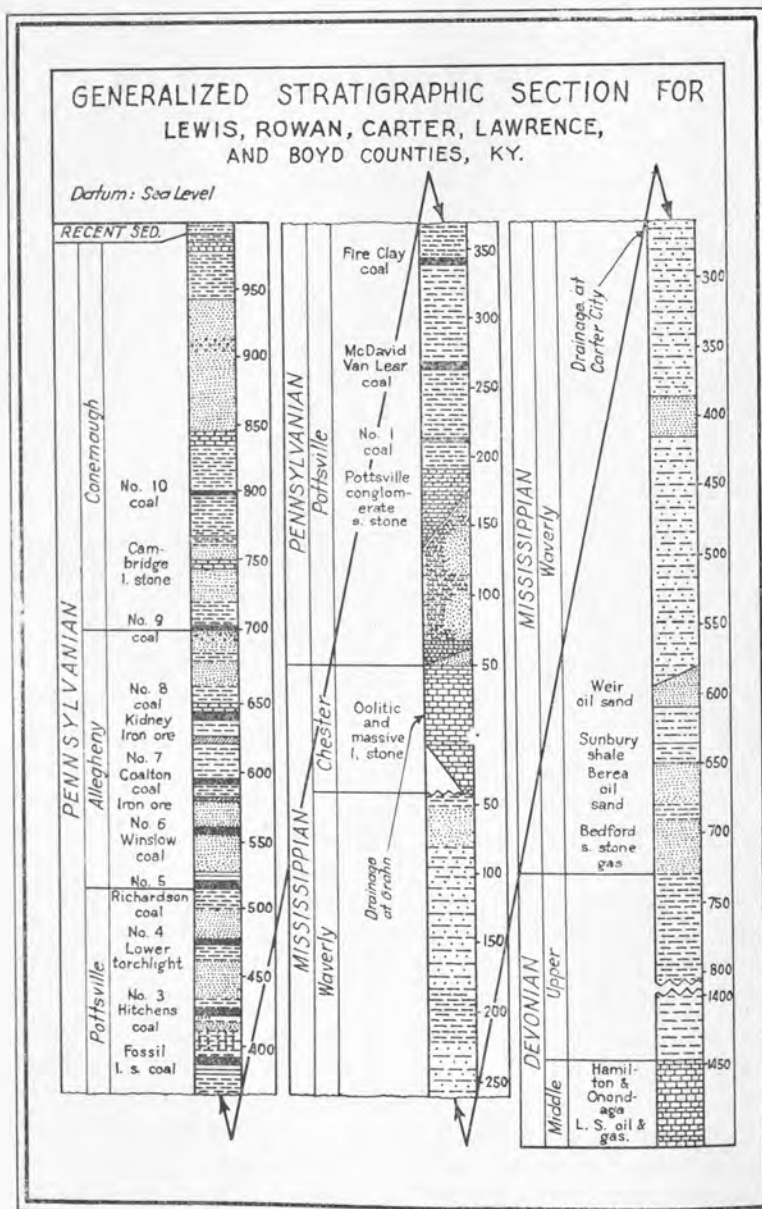
Laurel County has recently been mapped for oil and gas on the Fire Clay coal at the scale of 1 inch equals 1 mile. Two large doming anticlines delineated on this map, though indexed as possible producing areas, are practically untested at the present.

LXIV.

LAWRENCE COUNTY.

Lawrence County is situated in northeastern Kentucky adjacent to the State of West Virginia. It covers an area of 434.07 square miles. The Big Sandy River, with its major local tributaries, Blaine Creek and Cat Creek, drain the greater part of this district. The northwestern part of Lawrence County is drained, however, through Dry Fork of the Little Sandy River, while the southeastern part of the county is drained by Tug Fork of Big Sandy and its local tributary, Rockcastle Creek. A well defined unit in the Eastern Kentucky Coal Field, Lawrence County exhibits the typically entrenched meandering drainage of the maturely dissected Cumberland Plateau. Louisa, the county seat, situated on the river flood plain at the junction of the Tug and Levisa Forks of the Big Sandy, has an elevation of 582 feet. It is surpassed by upland bottoms and adjacent ridges to the south and southwest which rise to elevations of 1,200 and 1,250 feet.

The consolidated rocks of Lawrence County all fall within the Coal Measures and have been subdivided into three divisions: (1) Pottsville, (2) Allegheny, and (3) Conemaugh (Pennsylvanian). Alluvial sediments—sands, gravel and clays—composing the flood plains of the Levisa and Tug Forks of the Big Sandy, as well as the lower waters of Blaine and Rockcastle creeks, are of Pleistocene and Recent age. Situated regionally in the deep southwestern tip of the northwestern Kentucky Geosyncline, the structural attitude of the Paleozoic beds of Lawrence County is monoclinal, the inclination being normally to the north into the great plunging trough which strikes to the northeast into West Virginia. Because of this major structural feature, the Pottsville series is broadly exposed close to the boundary of the county on the south. As one proceeds northward towards Louisa from the south or southwest, beds increasingly high in the stratigraphic column extending up through the Allegheny and the Conemaugh are successively traversed. The northern part of this county exhibits in its uppermost beds



STRATIGRAPHIC SECTION FOR LAWRENCE AND ADJACENT
COUNTIES.

of Conemaugh age the youngest Paleozoic sediments in Eastern Kentucky.

The central portion of Lawrence County is crossed by the Hoods Creek Anticline. This structure rises on the lower waters of Laurel Creek and in the vicinity of Mattie, and plunges nearly due east, crossing the Big Sandy to Glenhayes in West Virginia. A few miles further north, parallel to this major fold, and also somewhat parallel to the axis of the geo-syncline but south of it, is found the Walbridge Fault, which strikes northeastward from the vicinity of Martha toward Busseyville and on into West Virginia. This pronounced break exhibits a throw varying from a few feet in the west to 100 and 150 feet as one follows it to the east.

The principal mineral resources of Lawrence County consist of oil and gas, and bituminous and cannel coal. In a sequence of about twenty seams, the following coals are of recognized value: The Van Lear or Miller's Creek, Peach Orchard, Lower Torchlight, and Upper Torchlight or Richardson coal. These coals are all in the Pottsville. Neither the Allegheny nor Conemaugh formations contain coals in this district of real importance. With the opening of many new and modern mines on the head of the Big Sandy, coal production here has steadily declined. In 1925 Lawrence County produced only 105 tons of coal for export. Oil and gas is produced in commercial quantities and excellent quality, from the Wier and Berea sands (Cuyhoga-Mississippian). The carbon ratio of the coal is 60.0. Natural gas has been secured in a number of places near the Elliott County line from the Corniferous (Devonian) limestone. Occasional disintegrated residual deposits of sands might be used for glass-making and general construction purposes. Iron ores falling within the group of the carbonates were formerly produced chiefly from the Pottsville in Lawrence County, but are not now considered to be of commercial importance from a competitive standpoint. Plastic fireclays associated with the Vanport limestone occur in Lawrence County in large amount following a crenulated belt defined by the periphery of the Lower Allegheny. Alluvial clays are available in the river bottoms for brick and tile making. A number of saline and otherwise

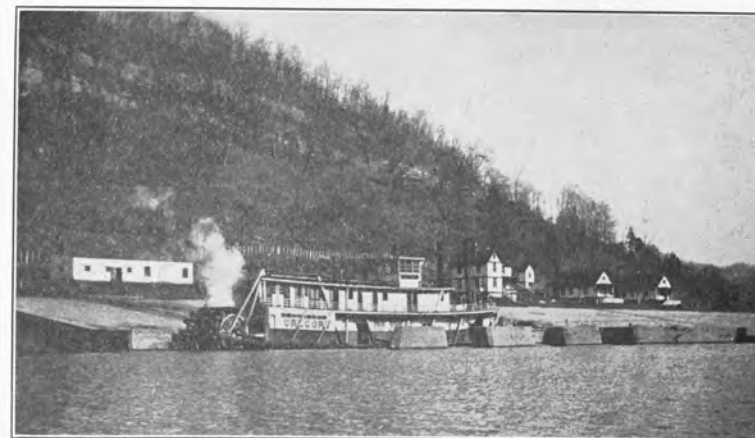
mineralized springs and wells are producing for local consumption in this district.

Lawrence County has twice been mapped structurally within recent years for oil and gas. The first, a surface map, is keyed on the Fire Clay coal (Pottsville), and the second, a sub-surface map, is figured on the Sunbury (Mississippian) shale. Each map is represented at the scale of 1 inch equals 1 mile. The topography of the county is available on the Kenova Quadrangle, scale 1:125,000. The geological folio prepared to accompany the quadrangle is now out of print and may be had only in large libraries. It is descriptive of the detailed geology of this entire district.

LXV.

LEE COUNTY.

Lee County is situated in the western central portion of the Eastern Kentucky Coal Field. Relatively small in area—covering only 209.28 square miles—the district is, however, quite typical of the foothills of the “Mountains” of Kentucky. It is drained by the North, Middle, and South Forks of the Kentucky River and a number of local tributaries, including Sturgeon and Mil-

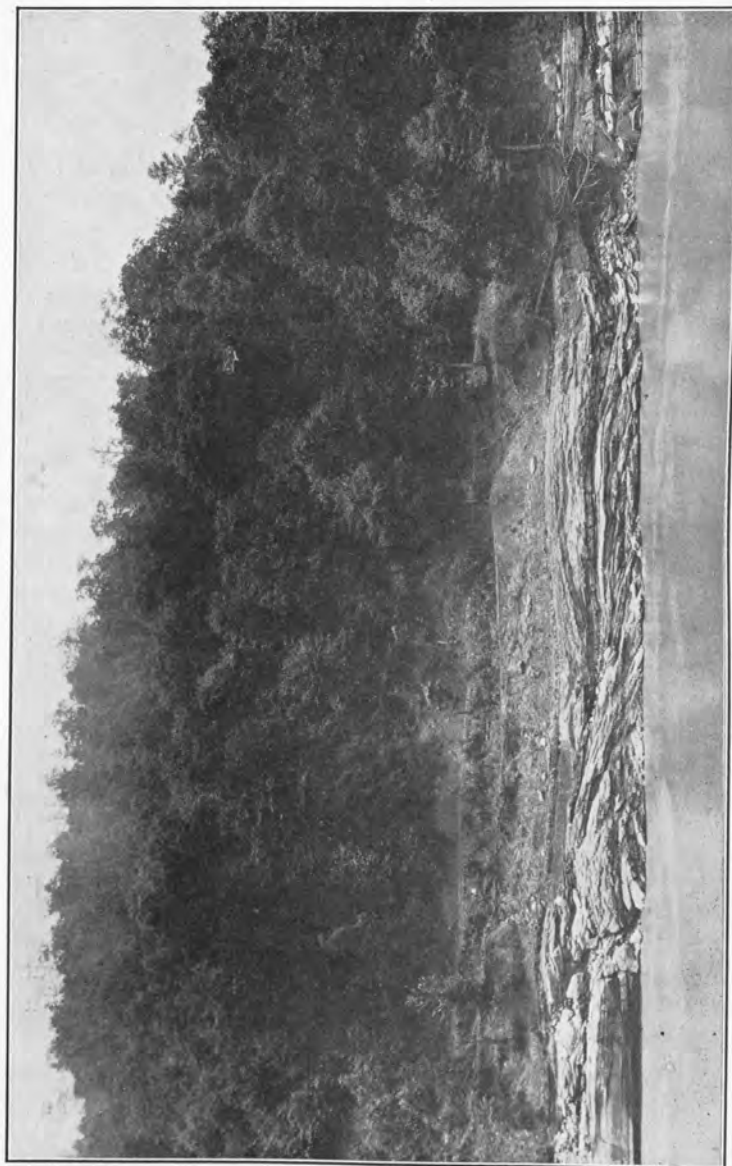


U. S. LOCK NO. 13, KENTUCKY RIVER.

There are in all fourteen Government locks on the Kentucky, slack waters reaching above Beattyville. This lock is near Willow Post Office, Lee County.

ler's creeks. Beattyville, the county seat, situated on the flood plain of the Kentucky River, has an elevation of 775 feet, but ridges to the south and southeast adjoining Owsley and Breathitt counties rise to upwards of 1,300 and 1,400 feet.

The hard rocks of Lee County consist for the most part of Coal Measure sandstones, sandstone conglomerates, shales and coals of the Pottsville (Pennsylvanian) formation. Underlying these sediments on the lower waters of Sturgeon Creek, the upper waters of Miller's Creek, and in the Kentucky River valley proper below St. Helens, there comes to outcrop the Gasper and



EROSIONAL UNCONFORMITY IN CHESTER ROCKS. This notable irregularity of sedimentation can be seen near the Government lock on the Kentucky River near Heidelberg, Lee County, Ky. The channel bed is the Glen Dean limestone (Mississippian), while the filling is Pottsville sandstone, shale and canal coals.

St. Louis limestones of Middle and Upper Mississippian age. The flood plains of the Kentucky River and the lower waters of Sturgeon Creek exhibit a thick unconsolidated mantle of sands, clays, and gravels which are of Recent and Pleistocene age. Structurally, Lee County is a monocline dipping to the southeast from a medial position on the eastern flank of the Lexington

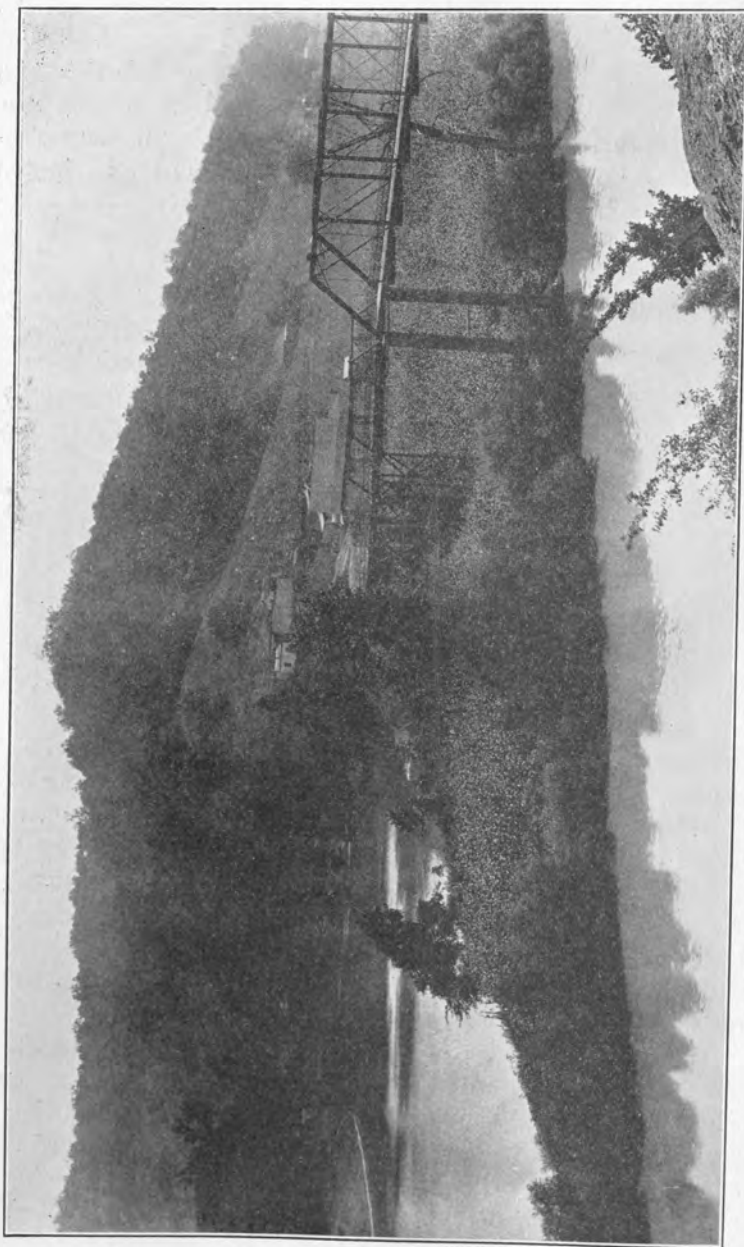


RIVER COAL MINE NEAR BEATTYVILLE.

This coal seam takes its name from the town near which it is located. It is a part of the lower Pottsville. The product is barged to Frankfort and other Kentucky River points.

Dome of the Cincinnati Arch. In detail this normal structure is considerably flexed with alternating anticlines of fingering outline plunging generally to the southeast. The county is not traversed by faults of significance, but is bounded closely on the north by the major east and west faulted structure of Kentucky, the Irvine-Paint Creek Fault, which undoubtedly has had much to do with the structural attitude of the consolidated Paleozoic sediments of this district, and their mineral economics. The carbon ratio of the coal ranges from 55.0 to 57.5.

The principal mineral resource of Lee County is petroleum, this product being secured from the "Corniferous" (Devonian) limestone at depths ranging from 500 to 1,400 feet. During a seven year period from 1919 to 1925, Lee County produced 23,279,193.95 barrels of oil valued at \$59,434,200.18. Bituminous coal occurring low down in the Pottsville series is mined at a number of different points for domestic consumption and is ex-



JUNCTION OF THE NORTH AND SOUTH FORKS OF THE KENTUCKY RIVER.
The view is looking upstream at Beattyville and the topography is typical of this region. The Beattyville coal occurs in these hills about tippie height above the bridge level—higher to the west, lower to the east.

ported from drift mines near the Kentucky River in the vicinity of Beattyville. During 1925 the exported coal production of Lee County totaled 5,900 tons, but much which was mined for local consumption is unrecorded. Natural gas is produced in small quantities. Transported sands occurring in the channel of the Kentucky River are available for general construction purposes, as are some disintegrated residual sands in isolated deposits. Alluviated clays and residual clay shales, suitable for the manufacture of common brick, are available. Limestones occurring near to the channel of the Kentucky River below Heidelberg are suitable for highway and roadbed construction, as well as for agricultural lime.

The oil and gas sub-surface structural geology of Lee County was executed in 1927 on the "Corniferous" (Devonian) limestone contoured at 10 feet to the scale 1 inch equals 1 mile. The topography of Lee County is available on the Beattyville Quadrangle, scale 1:125,000.

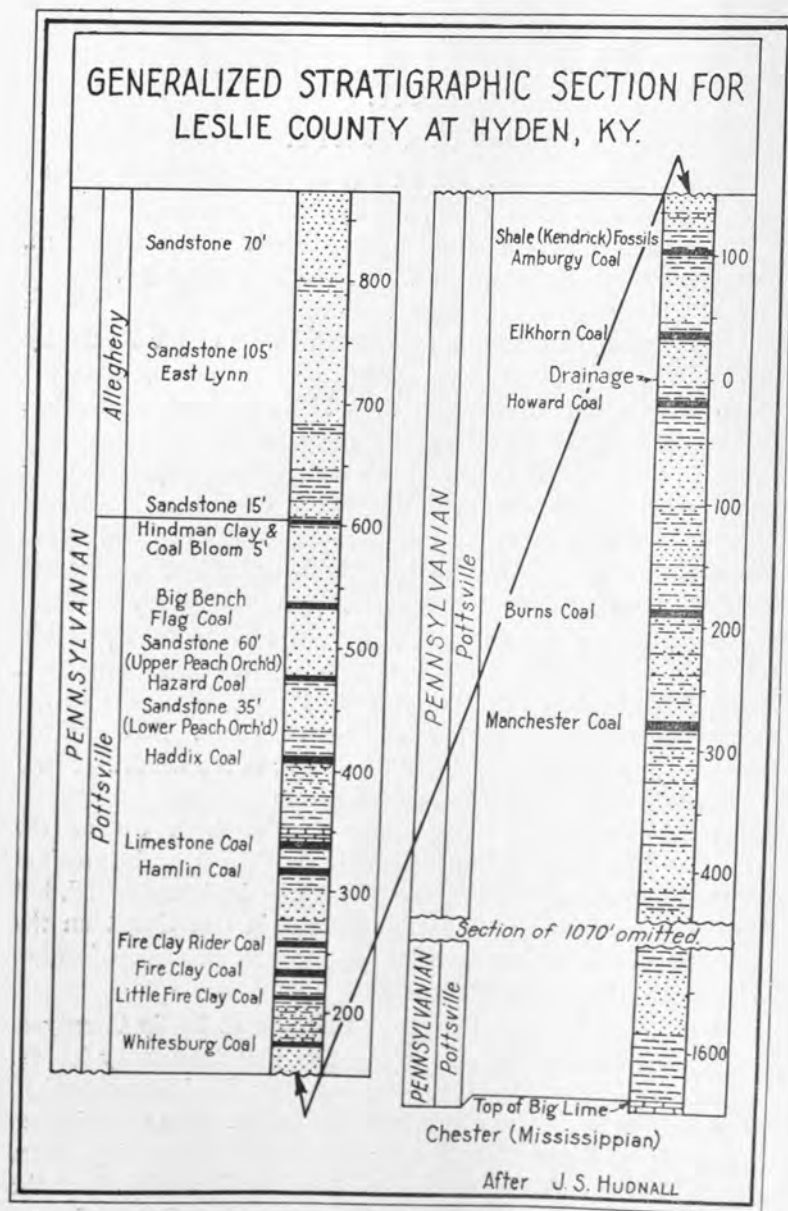
LXVI.

LESLIE COUNTY.

Leslie County is situated in the southeastern part of the Eastern Kentucky Coal Field, the typical "Mountain" region of this State. It covers 410.14 square miles. The district is a maturely dissected plateau in which the hills form a veritable maze of winding forested ridges with very steep slopes. Drainage is effected by the Middle and South Forks of the Kentucky River, the former penetrating all parts of the county with the exception of a narrow elongate area along the western border. The valley bottoms restricted and meandering, are frequently timbered, particularly on the upper waters. Hyden, the county seat, located at the mouth of Rockhouse Creek on the Middle Fork of the Kentucky River, has an elevation of 870 feet. Ridges surrounding rise generally to 1,600 feet, and along the Harlan County line attain elevations ranging up to 2,500 feet.

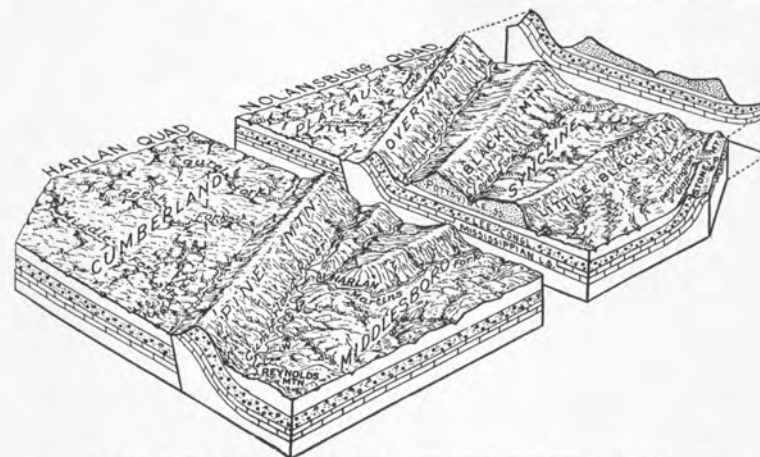
The rocks of Leslie County consist of sandstones, shales, and coals principally of the Pottsville series (Pennsylvanian). Some of the highest hills, however, in the southern part of the county contain clastic outliers of the Allegheny. Structurally, Leslie County is monoclinal, the dip being to the northwest into the Eastern Kentucky Geo-syncline which traverses a northeast and southwest line of strike across the northern tip of the county. A number of well marked anticlinal and synclinal features finger to the northwest. This district is unfaulted, but is so closely located to the Pine Mountain Overthrust on the southeast in Harlan County that the regional metamorphism has been greatly increased by it.

The most important mineral resource of Leslie County is bituminous coal, which, due to the fact that the county has no rail transportation, is only produced for local consumption. Some cannel coals also occur in this district. The most important coals of Leslie County are: the Hazard, Fire Clay, Flag, and Hindman. While neither oil nor gas is produced at the present time from Leslie County, it is recognized that sands productive of commercial quantities of both of these hydrocarbons



STRATIGRAPHIC SECTION IN LESLIE COUNTY.

are present beneath the surface of Leslie County at reasonable drilling depths. The production of one or the other or both of these mineral products may be expected following adequate



BLOCK DIAGRAMS OF SOUTHEASTERN KENTUCKY.

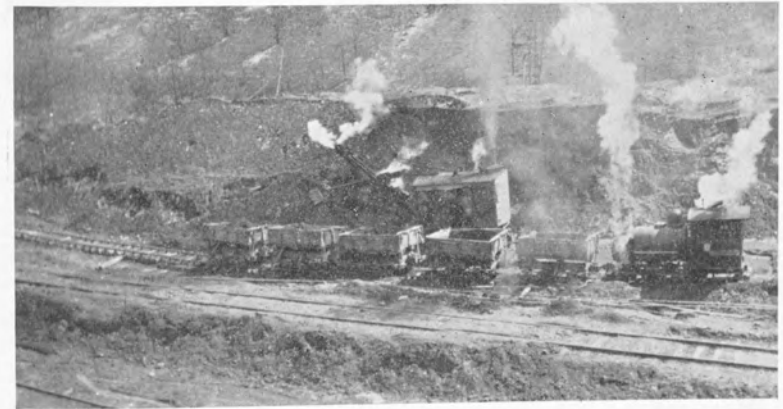
In the above drawing by A. K. Lobeck the structural geology and topography of parts of Leslie and Harlan Counties is shown.

exploratory work, but the possibilities of securing natural gas in commercial quantities are considered much better than those of petroleum. The carbon ratio of the coals ranges from 60.0 to 62.5. A detailed, inch to the mile, structural oil and gas map, keyed on the Fire Clay coal with 10 foot contour interval, was published of Leslie County in 1927. The area is entirely mapped topographically, as follows: Cumberland Gap and Manchester sheets, scale 1:125,000; Buckhorn, Cornettsville and Harlan quadrangles, scale 1:62,500.

LXVII.

LETCHER COUNTY.

Letcher County is situated in southeastern Kentucky adjacent to the State of Virginia. It encompasses an area of 349.77 square miles. This district, typically mountainous, is drained by the three master streams of Eastern Kentucky, the Big Sandy on the east, the North Fork of the Kentucky River



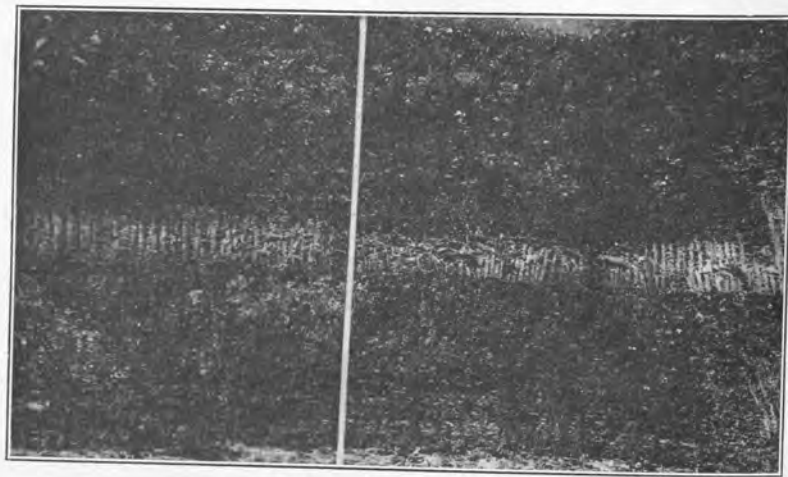
REMOVING SLATE SLIDE AT BURDINE.

Letcher County experienced its greatest landslide on February 3, 1923. Tens of thousands of tons of water-saturated mine "slate" dammed Elkhorn creek, flooding Burdine and causing great losses. An earthquake was involved.

throughout its central northern portion, and the Poor Fork of the Cumberland on the south. Within Letcher County are included portions of Kentucky's two mountains of real elevation, the Pine and Cumberland. Each of these mountains bounds the county about an equal distance on the south. Whitesburg, the county seat, situated in the flood plain on the headwaters of the North Fork of the Kentucky River, has an elevation of 1,163 feet, but is surrounded by a maze of ridges, the summits of which give figure to the Cumberland Plateau and attain elevations rising upwards to 2,000 feet. The Pine Mountain, which traverses the county along a line striking north 60 to 70 degrees east over a distance of about 38 miles, attains

elevations ranging from 2,263 to 2,900 feet, while the Cumberland Mountain, somewhat further to the south, is slightly higher and attains a maximum elevation of about 3,650 feet.

The rocks of Letcher County consist entirely of Paleozoic sediments ranging from the Chattanooga (Upper Devonian) black shale upwards through the entire sequence of the Missis-



THE ELKHORN COAL, JENKINS, KY.

This coal, one of the last to be opened for national consumption, is now widely developed in its field and is assured a full and continuous operation for the next several generations.

sippian System and well up into the Pottsville series of the Pennsylvanian. Bituminous shales characterize the surficial representatives of the Devonian; limestones and sandy to calcareous shales and sandstones represent the Mississippian, while clastics consisting of sandstones, sandstone conglomerates, shales and coals typify the Pennsylvanian and constitute the surficial rocks of more than 95 per cent of this district, the Devonian and Mississippian representatives being present at the surface only on the northwest flank of the Pine Mountain. Recent alluvial sediments consisting of sands, gravels, and clays are found in the bottoms of the upland streams draining this district. The structural pattern of Letcher County is an overthrust faulted monocline tilted to the northwest, the southern tip of which—that portion between the Pine Mountain and Cumberland Mountain

adjacent in Wise County, Virginia—is a dominant regional syncline plunging to the southwest. Except for the Pine Mountain overthrust fault along which there has been Post-Paleozoic movement to the northwest possibly attaining a horizontal displacement of several miles, there is no faulting in Letcher County of consequence.

The principal mineral resource of Letcher County is bituminous coal, though small amounts of cannel are also produced. In the year 1925 about 5,989,957 tons of coal were mined for



OPERATING MINE NO. 201, ELKHORN COAL.

This is one of the most important mines in the Elkhorn field, which centers about Jenkins, Ky. The coal is widely recognized as of a very superior quality. It is of Pottsville age.

export in this district. The chief commercial seams of Letcher County are the Wayland, Elkhorn, Whitesburg, Fire Clay and Hindman coals. Favorable doming and anticlinal structure in Letcher County suggests the possibility of securing some amounts of natural gas following adequate exploration. Sands producing natural gas elsewhere in Kentucky are known to be existent at reasonable drilling depths in this region. The carbon ratio for this district is 60 to 62.5, and this ratio is considered to be somewhat too high for commercial amounts of petroleum. Residual sands suitable for general construction purposes are available. Sandstones here somewhat regionally metamorphosed are quarried and used for local building and bridge abutment construction. Limestones brought up by the Pine Mountain Overthrust are available for highway and railroad bed construction, but are too generally shattered to be use-

ful for building purposes. The calcareous content of these limestones is frequently high, rendering them suitable for use as agricultural lime. A number of caves exist in these Mississippian limestones along the northwestern flank of Pine Mountain and afford a regional resource in the form of subterranean scenery which within recent years appears to be of growing importance.

An oil and gas, and structural map of Letcher County, keyed on the Fire Clay coal, scale 1 inch equals 1 mile, was prepared in 1926 and is available. The Fourth Geological Survey published a detailed report describing the geology and coals of Letcher County in 1915, but this volume has been out of edition for several years. The topography for this district has been executed on the Hindman, Pikeville, Pound, Whitesburg, Big Stone Gap, Nolansburg, and Cornettsville sheets, scale 1:62,500.

LXVIII.

LEWIS COUNTY.

Lewis County is situated in northeastern Kentucky adjacent to the State of Ohio. Exhibiting a total of 491 square miles it constitutes the toe end of the Kentucky Knobs Belt east of the Bluegrass and is drained by Kinniconick and Salt Lick creeks, northeastward flowing tributaries of the Ohio River. The ter-



CLIFF OF BEREIA SANDSTONE.

This outcrop is just south of Vanceburg, Lewis County. The Berea here is about 22 feet thick.

rain of Lewis County is hilly throughout, the general relief being about 250 feet. Vanceburg, the county seat, on the Ohio River has an elevation of 528 feet.

The hard rocks of Lewis County consist of a rather long sequence of Paleozoic sediments ranging from the uppermost Ordovician beds upwards through the Silurian, Devonian and Mississippian into the basal Pottsville (Pennsylvanian). Both clastic and organic sediments involving limestones, sandstones, sandstone conglomerates, shales and a few coal streaks are embraced within this stratigraphic sequence. The lower waters of Kinniconick and Salt Lick creeks as well as the entire flood

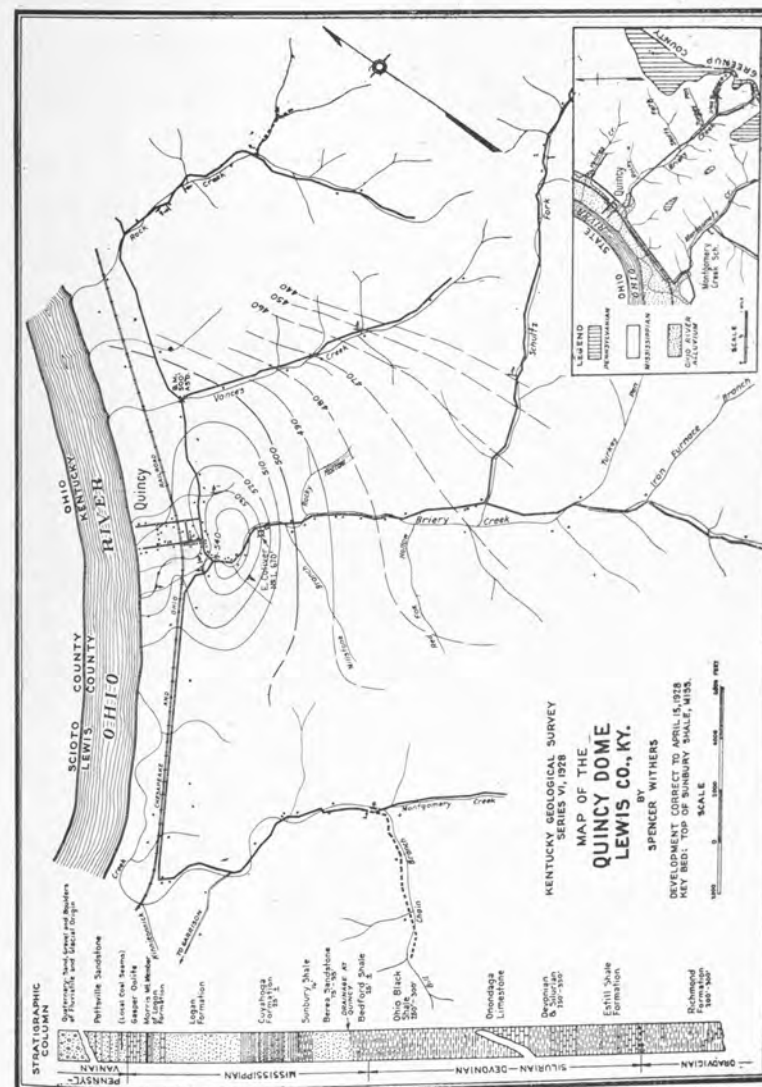
plain of the Ohio River bounding the county on the north exhibit thick alluvial sediments of Recent and Pleistocene age. These consist of sands, clays, and gravels, some of which are of glacial derivation. Old glacial deposits of infrequent occurrence are represented by an isolated gneissic boulder of Canadian source weighing upwards of 15 tons in the southwestern part of the county near Epworth. The structural geology of Lewis County is best described as an eastward dipping monocline, unfaulted. The Paleozoic platform is flexed throughout, however, by fingering anticlines and synclines plunging to the east.



NORTHEAST FLANK OF QUINCY DOME.

One of the most symmetrical structures in this part of Kentucky is this Lewis County dome near the Ohio river. It has been drilled to the Corniferous.

The principal mineral resource of Lewis County is limestone which is available in unlimited quantities for highway, railroad and general building construction. Some limestones of Upper Mississippian age occurring in the high "Knobs" of eastern Lewis County are highly calcareous, and are suitable for agricultural purposes. Oil and gas in small quantities have been found in drilled wells, but commercial production of these fuels is not established though the prospect for the development of a few small pools is a reasonable assurance due to the fact that the "Corniferous" (Devonian) limestone, so productive in Estill, Powell, Lee, Wolfe district underlies most of Lewis County at reasonable drilling depths. Ohio (Devonian) black shales suitable for artificial oil extraction are present throughout



SKETCH MAP OF QUINCY DOME

the northwestern part of Lewis County in unlimited quantities constituting a future source of artificial petroleum. Clays suitable for brick making, and sands and gravels of a requisite quality for general construction and highway work are available in the northern part of the county, particularly in the flood plain and channel of the Ohio River.

An areal geological map of Lewis County prepared in 1925 to the scale of 1 inch equals 1 mile, is available, but no topography has been executed for this district.

LXIX.

LINCOLN COUNTY.

Lincoln County is situated in central Kentucky, and is somewhat unique in that it embraces parts of three major geographic divisions: (1) the Outer Bluegrass in the north, (2) the Knobs



OLD WHITLEY HOME IN LINCOLN.

Made originally of local materials, it is the first brick house in Kentucky. Its stairway and much of its interior trim is of black walnut. William Whitley's initials in brick-laid pattern may be seen above the door. The formal Colonial front is recent.

Belt passing through Crab Orchard and McKinney, and (3) the northeastern Pennyroyal in the vicinity of Kings Mountain and Waynesburg. In keeping with this triplicate geographic division, the northern drainage is confined to the Dix River, a tributary of the Kentucky. The southwestern drainage is claimed by the headwaters of the Green River, while the Rockcastle through Buck Creek drains all of southeastern Lincoln County. Areally it contains 321.85 square miles. Stanford, the county seat, has an elevation of 912 feet, and is representative in altitude of the Outer Bluegrass Plain surrounding. The central portion of the county is traversed by a very remarkable erosional scarp known as "Muldraugh's Hill" which follows the Devonian-Mississippian outcrop along a generally east-west direction entirely across the county. It is 350 feet higher than the plateau on which Stanford is situated. Hall's Gap one of

the most accessible and strategically scenic routes of ascent over this great barrier affords excellent opportunity to strongly contrast the low lying northern Ordovician plain with the Mississippian Plateau on the south.

The rocks of Lincoln County consist of a long sequence of Paleozoic sediments—limestones, sandstones, shales and residual sandstone conglomerates ranging from the upper portion of the Camp Nelson (Lower Ordovician) beds upwards to and including a part of the Fort Wayne and Warsaw limestones (Mississippian). In this sequence are representatives of the Mohawkian, Cincinnati (Ordovician), Niagaran (Silurian), Middle and Upper Devonian, and the Lower Mississippian. Residual disintegrated conglomerates from the Pottsville (Pennsylvanian) cap some of the ridges. The structural aspect of Lincoln County is that of a generally southward tilted monocline located on the southern flank of the Lexington Dome of the Cincinnati Arch. The regional structure of this district, however, is not uniform throughout but presents several subdistricts which are widely in contrast. The northern part of the county is bisected by a fault zone exhibiting locally most pronounced disturbances. This distance is known further to the north in the Bluegrass as two separate structural features: the Kentucky River Fault, and West Hickman-Bryant Station Fault, which combined pass through the vicinity of Burdette's Knob in Garrard County and crossing the Dix River near Hubbell, strike southwestward a few miles west of Stanford. This belt of north-south faulting is intercepted by faulting and folding striking slightly south of west, and located a few miles north of the general trend of the pronounced "Muldraugh's Hill" escarpment. Associated with this major east-west flexure and north and south zone of faulting, there are many dips of high angle, though elsewhere in the county, particularly in the northwest and on the southeast, the normal tilting of the Paleozoic platform is low in angle ranging between 20 and 30 feet to the mile.

The principal mineral resource of Lincoln County is limestone which is found in both the northern and southern parts of the district in unlimited quantities for all general purposes of rural building construction, highway and railroad bed use. Some southern and northern Lincoln County limestones are suitable

for agricultural lime. Oil and gas have developed in commercial quantity on the headwaters of the Green River and Rockcastle River, and in the small Floyd and Buck Creek pools both of which were developed a few years ago at very shallow depths. Residual clays suitable for brick making are available in the northern as well as southern parts of the district. Throughout



HILL ROAD TO HALL'S GAP.

The Devonian and Mississippian escarpment in Lincoln County gives rise to one of the most scenic automobile routes of Central Kentucky.

the "Muldraugh's Hill" region the Chattanooga (Devonian) black oil shale coming to outcrop affords large future supplies for artificial petroleum.

A geological map of Lincoln County has recently been executed showing the fault pattern, scale 1 inch equals 1 mile, and is now available. The topography of the northern part of this county is presented on the Harrodsburg Quadrangle, scale 1:125,000.

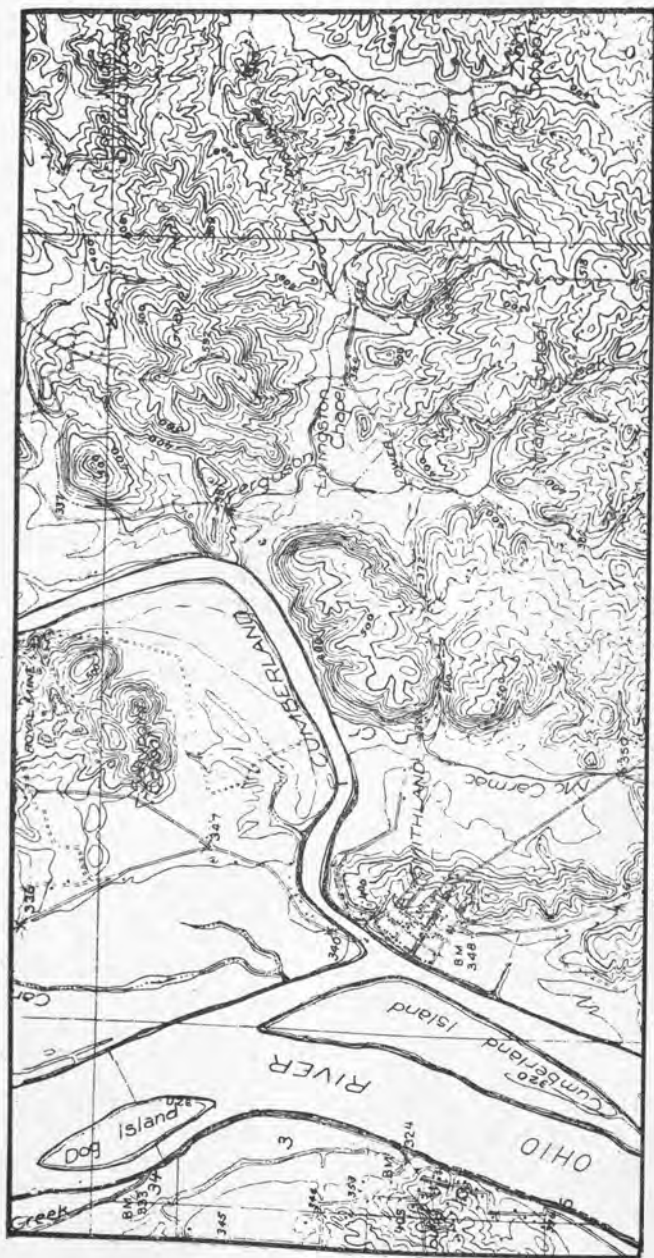
LXX.

LIVINGSTON COUNTY.

Livingston County is situated in the western tip of the Pennyroyal adjacent to the State of Illinois. It covers an area of 344.50 square miles. It is drained by the lower waters of three master streams of the Eastern Interior of the United States: (1) the Cumberland River, (2) the Tennessee River, and (3) the Ohio River and their local tributaries. Livingston County is hilly throughout its central and eastern portions but drops away rather sharply on the west to low bottoms bordering the Ohio River. Smithland, the county seat, situated at the juncture of the Cumberland and Ohio rivers has an elevation of 335 feet above sea level.

The hard rocks of Livingston County consist of limestones, sandstones, sandstone conglomerates, shales and coals of the Osage, Meramec and Chester divisions of the Mississippian, and the Lower Pottsville group of the Pennsylvanian. The district is traversed by a belt of mica peridotite (igneous) dikes which strike out of Crittenden County on the east, north 45 degrees west across the Ohio River into Illinois. Several of these dark basic intrusions have been mapped on the Golconda Quadrangle. They usually involve Mississippian rocks, but are regarded as post-Paleozoic in age, though some of them may be more recent.

The unconsolidated sediments of Livingston County consist of Cretaceous gravels of Tuscaloosa age associated with some undifferentiated Tertiary sands and clays, and a rather heavy mantle of fluvial sands, gravels and clays of Pleistocene and Recent age. The latter are all associated with the flood plains of the Ohio, Tennessee and Cumberland rivers. These deposits contain a considerable amount of reworked glacial debris. The structural geology of Livingston County presents broadly the features of a highly flexed and faulted Paleozoic platform normally inclined to the southwest, its regional position being on the western flank of the Kuttawa Arch of Western Kentucky. In detail the fault pattern of Livingston County constitutes an intercepting series of normal faults striking generally northeast



TOPOGRAPHY IN WESTERN LIVINGSTON COUNTY
This county has been mapped on the Golconda, Smithland and Cave-in-Rock quadrangles at 1:82,000. Physical features are shown here in the vicinity of Smithland, Ky.

and southwest interfretted with many tangential cross faults of short extent. It is a veritable mosaic.

The principal mineral resource of Livingston County is Fluorite, CaF_2 , which is produced in commercial quantity from mineralized veins following lines of fissure faulting in various parts of the county. Due to inadequate rail transportation the very considerable mineral reserve of Livingston County is but slightly developed at the present time. Limestones suitable for building, highway and railroad bed construction as well as agricultural lime are available in the Chester (Upper Mississippian) section throughout the central and eastern parts of the county. Some residual sands in isolated deposits are available for general constructional purposes, while some of these sands have been indicated as of sufficient purity for glass making. Transported sands and residual friable sandstones, sands and gravels suitable for highway and general construction purposes have been produced from the Ohio River. A few thin seams of coal developed in the Pottsville "graben" in the northwestern part of the county near Carrsville have been mined for local domestic consumption. Residual clays suitable for brick making are available in unlimited quantities.

In the faulted areas associated with fluorite veins and igneous dikes are generally found minor deposits of galenite, sphalerite, chalcopryrite, hydrozincite, cerussite, calcite and pyrite. Not infrequently some of these minerals and ores are found occurring in quantity and quality of commercial importance, and some of them have been operated and exported.

This district has been mapped in detail geologically (fault pattern) on the Golconda, and Cave-in-Rock quadrangles. The areal and structural geology has been executed separately for the Golconda, Cave-in-Rock and Smithland quadrangles; but these are at the present unpublished. The topography of this district is available on the same sheets, scale 1:62,500. A reconnaissance geological map of Livingston County was published in 1926 to the scale 1 inch equals 1 mile. It shows the location of the fluor-spar mines and the fault pattern so important to the mining development of this district.



WESTERN KENTUCKY FLUORITE.

LXXI.

LOGAN COUNTY.

Logan County is located in the central southern portion of the Pennyroyal of Kentucky adjacent to the State of Tennessee. Areally it encompasses about 643 square miles. It is drained by the Gaspar and the Mud rivers, north flowing tributaries of the Green River, and the Red River, a southwest flowing tributary of the Cumberland River. The terrain of Logan County is quite widely diversified. The northern portion of this district is hilly and clifty, and exhibits a maximum relief of 300 feet. The southern and central portions of the county are undulating to rolling, and interspersed with many sink holes. In the vicinity of the ridge lands surrounding Russellville there is developed a somewhat typical Karst topography. Russellville, the county seat, has an elevation of 550 feet which is exceeded by some ridge lands to the north rising to 740 feet; while much lower elevations are found at the Tennessee line on the Red River, and on the Muhlenberg and Warren County lines on the Mud and Gaspar rivers.

The rocks of Logan County consist entirely of Carboniferous sediments—limestones, sandstones, sandstone conglomerates, shales and coals. The major portion of the county is covered by beds in the Meramec and Chester series of the Mississippian. Pottsville (Lower Pennsylvanian) sediments appear in the northwestern part of the county adjacent to the Muhlenberg County line. Alluvial sediments principally of Recent age are found in the river and creek bottoms, particularly in the low waters of Mud River. The structural geology of Logan County is best described as monocline tilted slightly to the northwest with low angles of inclination in the southern and central portions of the county. These dips greatly increase as one proceeds northwest towards the Western Kentucky Coal Basin. The northern part of the county is somewhat broken by several normal faults striking generally slightly north of east. The Paleozoic platform is regionally flexed by a number of anticlines and synclines of low angle, generally of the terracing type, though

some of fingering character plunge into the Western Kentucky Coal Field.

The principal mineral resource of Logan County is limestone which is found in large quantity and in quality suitable for building construction, highway and railroad bed use. Certain horizons in the Chester (Upper Mississippian) series, particularly the Gasper limestone are high in calcareous content and are suitable for agricultural lime. Considerable deposits of asphaltic impregnated sandstones (Cypress-Chester age) occur well dis-



CHESTER ASPHALT IN LOGAN.

These asphaltic outcrops of the Cypress sandstone occur shortly north-east of Russellville in the vicinity of Browning's Store.

tributed through the northeastern and north-central parts of Logan County, and have been operated to a considerable extent, particularly near Browning's store, for road surfacing materials. A few thin coals occur in northwestern Logan County, and have been used for local consumption. Oil and gas have been indexed at a number of points, particularly in the vicinity of South Union and near Diamond Springs; and it is probable that larger deposits will eventually be developed following adequate exploratory work. Residual clays suitable for brick and tile making are present in large amounts well distributed.

An oil and gas map of Logan County published in 1924 to the scale of 1 inch equals 1 mile is available, but with the exception of the northern part of the county which is presented on the Drakesboro, Dunmore and Little Muddy sheets, this district is not surveyed topographically.

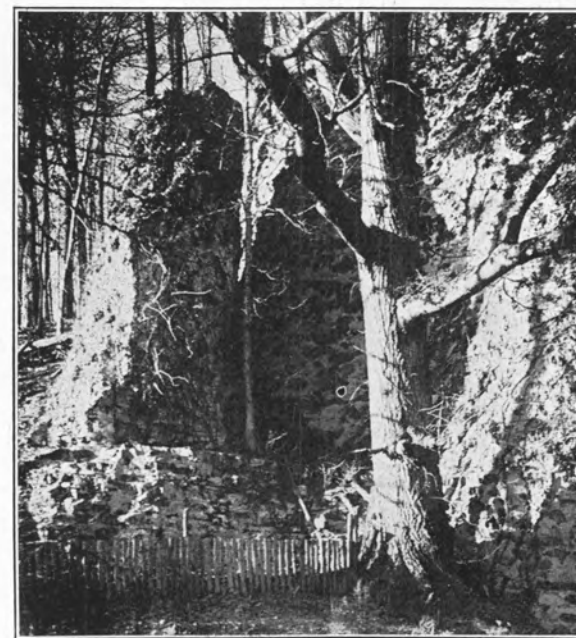


BOUND REPORTS OF THE KENTUCKY GEOLOGICAL SURVEY FROM 1854-1928.

LXXII.

LYON COUNTY.

Lyon County is situated in the western tip of the Pennyroyal of Kentucky adjacent to the Jackson Purchase Region on the southwest. It covers an area of 266.36 square miles. The district is drained by the lower waters of the Cumberland and



CHERTY ST. LOUIS LIMESTONE.

This outcrop, known locally as "Buzzard's Roost," exhibits a well developed alteration to chert nodules so characteristic of this Mississippian unit.

Tennessee rivers and their local tributaries, the largest of which is Livingston Creek bounding Lyon County on the northwest. Eddyville, the county seat, situated in an old meander of the Cumberland River has an elevation of 350 feet. The average physical relief of Lyon County is 200 feet.



FAULT IN CUMBERLAND RIVER BELOW KUTTAWA.
This part of Western Kentucky is in the highly deformed area. Faults of northeast-southwest strike and east-west strike generally are common in the Mississippian limestone.

The hard rocks of this district consist of Chester and Meramec (Mississippian) limestones, sandstones and shales, of which the St. Louis limestone covers the greatest areal extent. Chester sediments outcrop principally in the immediate vicinity of Livingston Creek, the remainder of the district exhibiting either at the surface or at shallow depths beds of Meramec age. Superimposed upon the eroded Mississippian surface are Cretaceous gravels of Tuscaloosa and Eutaw age intermingled in some localities with unconsolidated sands and clays of Tertiary deposition. In the flood plains of both the Cumberland and Tennessee rivers there are alluviums which are of Pleistocene and Recent age. The structural geology of Lyon County is a faulted monocline



CRETACEOUS GRAVELS IN SOUTHERN LYON.

These unconsolidated deposits occur in between the rivers somewhat northwest of the Hillman Ferry.

dipping to the southwest from the top of the Kuttawa Arch, the axis of which strikes about north 45 degrees west just within the eastern boundary of the county. The fault pattern of Lyon County is complex; the normal regional strike of the faults ranges from north 60 degrees east to north 85 degrees east. These major faults are intercepted at various angles by cross fissures tangentially traversing the larger fault blocks.

The principal mineral resource of Lyon County is fluorite, CaF_2 , which as a deposit is for the most part undeveloped. It

occurs in mineralized veins which are identical with the fault planes, though all fault planes are not mineralized. Associated with the fluorspar are galenite, sphalerite, barite, calcite and other rare minerals such as hydrozincite, cerussite, and chalcopryrite. Limestone is a mineral resource of great value in Lyon County. Widely separated deposits in this district are suitable for operation for building stones, highway and railroad bed material, as well as agricultural lime. Transported sands are producible for general construction purposes from both the Cumberland and Tennessee rivers, and residual gravels of Cretaceous age closely adjacent to transportation are available in unlimited amount for highway and railway right-of-way and building construction.

A reconnaissance geological map of Lyon County was published in 1926 to the scale 1 inch equals 1 mile. A portion of the structural geology and topography of this district has been presented and published on the Princeton Quadrangle. The Eddyville area was mapped topographically in 1928 and will be available in preliminary form as a photolithograph at the scale of 1:48,000 early next year.

LXXIII.

MADISON COUNTY.

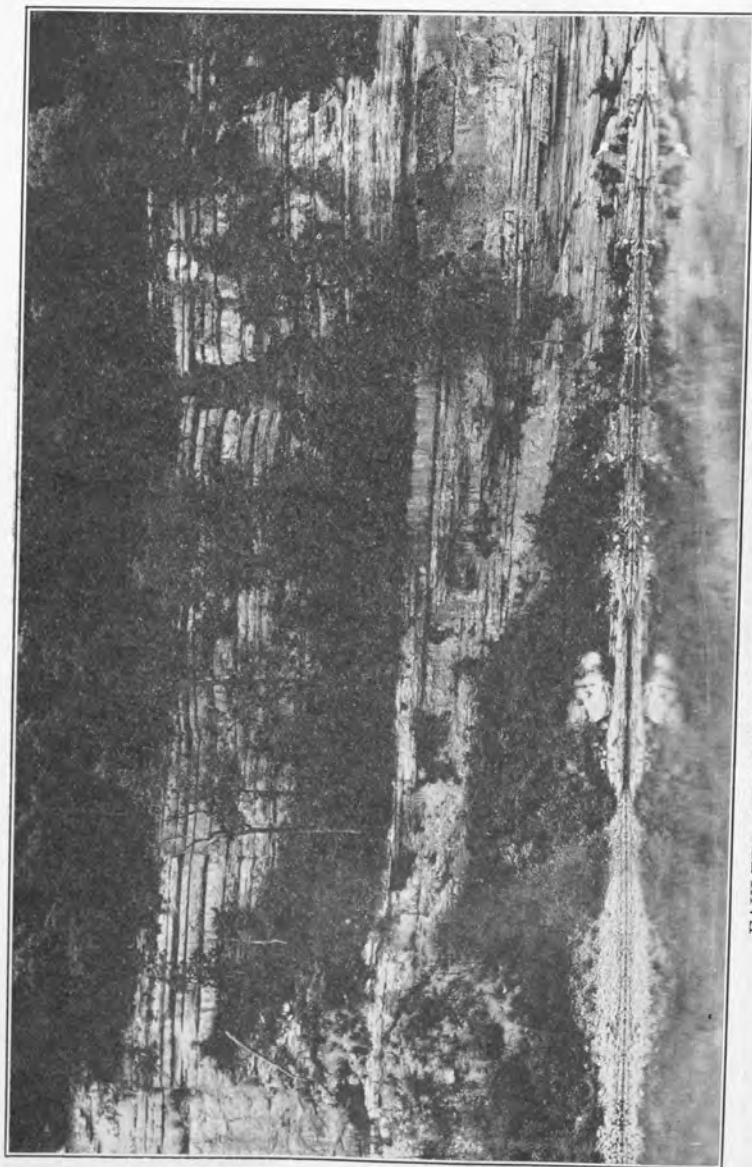
Madison County is situated partly in the Outer Bluegrass Region of Kentucky and partly in the "Knobs." It covers an area of about 446 square miles. The Bluegrass portion is an undulating to rolling upland plain bounded by precipitous



OLD HAND POTTERY NEAR WACO.

The clay used here to produce blue and red pottery and stoneware is an old upland river deposit of Tertiary age. It is gray white in the pit and turns to a light tan when burned unglazed.

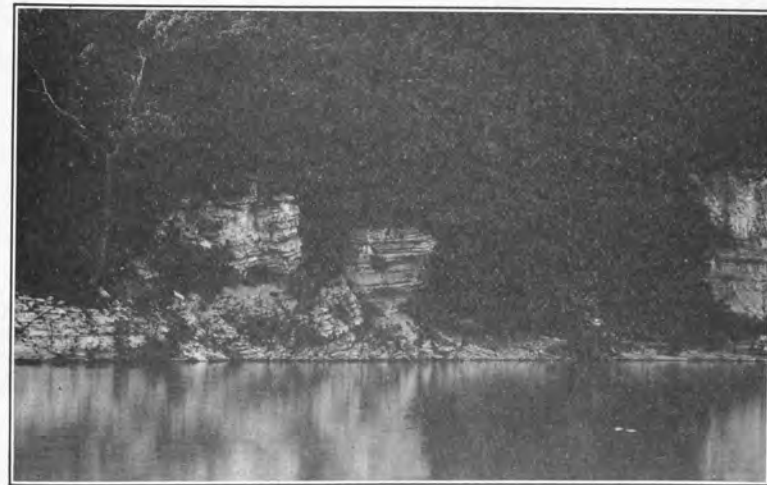
topography along the gorge of the Kentucky River and its larger local tributaries on the northwest. The southeastern part of Madison County embraces a considerable extent of the "Knobs" area in which summit elevations of the hills and ridges, ranging up to 1,630 feet, are representative in figure of the northwestern margin of the Cumberland Plateau. Richmond, the county seat, has an elevation of 950 feet, which is quite characteristic generally of this portion of the Bluegrass plateau. The location of Berea on a low flat hill at an elevation of 1,005 feet is typical of dissected remnants of the Lexington peneplain in the "Knobs" Belt; while the summit elevations of nearby hills in the southeastern portion of the county, such as Bear Mountain, rise to 1,450 and 1,630 feet. The minimum elevation of this district is 550 feet and occurs in the Kentucky River gorge at the mouth of Paint Creek. It is thus evident that while the



FAULTED ORDOVICIAN LIMESTONES NEAR BOONESBORO.
Though the displacement in this locality in Madison County is not great, this disturbance—a part of the great Kentucky River Fault Zone—is of wide regional significance. Sharp dips are found shortly to the south.

local relief may not, and frequently does not, attain as much as 150 feet, particularly on the limestone plateau near Richmond, the maximum relief for the district as a whole is about 1,100 feet.

The district is drained by the Kentucky River through Paint, Silver, Bates, Otter, Muddy, Drowning, and Red Lick creeks. The hard rocks of Madison County consist of a long sequence of Paleozoic sediments—limestones, sandstones, sand-



CLAY'S FERRY FAULT.

The drag zone of this well known Madison County disturbance is clearly shown. The uncovered beds are Ordovician limestones.

stone conglomerates, shales, and coals, which begin with the High Bridge limestone in the Champlainian (Ordovician) and continue upwards through the Cincinnati (Ordovician), the Silurian, the Devonian, and the Mississippian series into the basal clastic sediments of the Pennsylvanian. Unconsolidated sands, gravels, and clays of Pliocene age and fluvial origin known as the "Irvine" formation, cap the hills as outliers close to the Kentucky and Red rivers. Pleistocene and Recent alluviums compose the flood plain deposits of the Kentucky River and the lower waters of its larger tributaries.

The structural geology of Madison County is essentially that of a tilted monocline dipping southeastward from a mediumly high flank position on the Lexington Dome of the Cin-

cinnati Arch. The southern part of the county is traversed by a sinuous line of normal faulting and folding which is in fact a part of the Irvine-Joe Lick Fault Zone. Displacements of 50 to 150 feet (Combs Mt.) are in evidence. The northern part of the county is traversed by the Kentucky River Fault which, crossing and re-crossing the Kentucky River near the mouth of Boone Creek, passes through the northern tip of Madison County in the vicinity of Lower Howard Creek. The displacement at this locality is slight, but the angle of flexure on the south immediately adjacent to the fault is so great as to give a change in the structure of 300 feet within a very short distance. The



KENTUCKY RIVER AT VALLEY VIEW.
Low rounded topography takes the place of the steep vertical cliffs of the gorge as one ascends this stream.

great block of Madison County lying between the Irvine-Joe Lick Fault on the south and the Kentucky River Fault on the north is flexed into a number of minor anticlines and synclines of fingering characteristic with axial trend for the most part to the southeast.

The principal mineral resource of Madison County is limestone, which is widely distributed and available in quality and quantity suitable for rural building construction, highway and railway use. Certain grades of limestones in this district, particularly in the "Knobs" Belt where Chester beds recognized as correlatives of the Gasper are available, are sufficiently high in calcareous content to be suitable for agricultural lime. Transported clays of Tertiary age occur in the vicinity of Waco and are used for pottery and stoneware making. Paleozoic residual clays and clay shales are available for brick and tile manufac-

ture. Sands suitable for general constructional purposes are available from the waters of the Kentucky River and from isolated residual deposits in the "Knobs" Belt. Disintegrated gravels and sands of residual character from the basal Pottsville in the "Knobs" Belt are frequently available for highway and concrete construction.

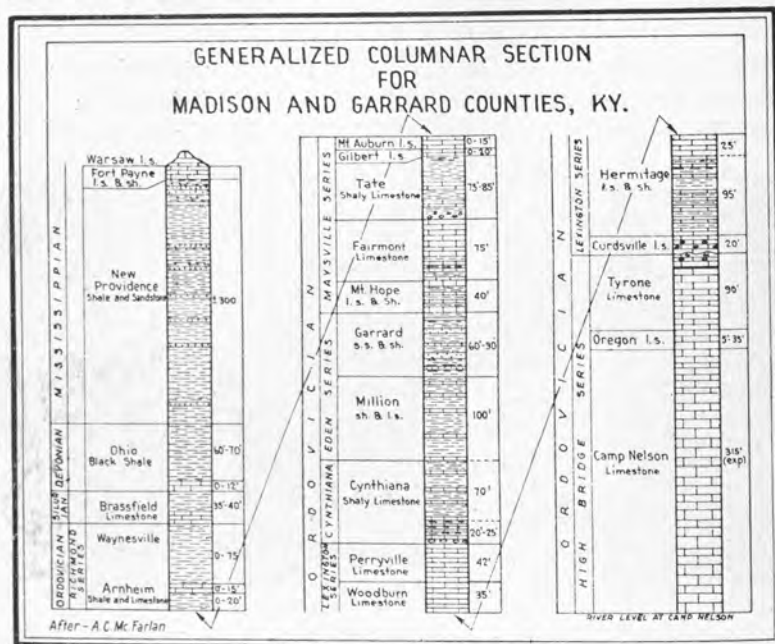
The southeastern part of Madison County is underlain by the Corniferous (Devonian) oil "sand" which has been very largely productive at shallow depths immediately to the north-



DEVONIAN SEDIMENTS NEAR BRASSFIELD.
The limestone shown is the Corniferous. This is overlain by remnants of the Chattanooga shale.

east in the vicinity of Irvine and Beattyville. The underlying Niagaran (Silurian) limestone also productive of oil and gas in Estill, Breathitt, Bath and other eastern Kentucky counties, is present here in southeastern Madison and is a possible but probably a more remote producing horizon. Small oil and gas production has been reported from a number of exploratory wells. Coal is produced for regional consumption from isolated ridge deposits in the vicinity of Morrill, Big Hill, and other localities a few miles southeast and east of Berea. Small amounts of fluorite and calcite have been reported from Madison County. The belt of the outcrop of the Chattanooga (Devonian) black shale affords a large ultimate reserve for the manufacture of artificial petroleum.

An old geological map of Madison County, prepared by the Second Geological Survey, to the scale 1 inch equals two miles, is available. The area has been topographically mapped on the Richmond Quadrangle scaled 1:125,000. The Richmond folio,



STRATIGRAPHIC SECTION FOR PARTS OF MADISON AND GARRARD.

U. S. G. S., though only available now in libraries, presents a general account of the geology of the entire district, while a special report of the geology and mineral resources of the region about Berea has recently been published by the Sixth Kentucky Geological Survey. A new base map of Madison County, scaled an inch to the mile, is now being surveyed in the field.

LXXIV.

MAGOFFIN COUNTY.

Magoffin County is centrally situated in the Eastern Kentucky Coal Field. It contains about 302 square miles and is drained entirely by the headwaters of the Licking River, with the exception of a few square miles in the vicinity of Ivyton. Here the actively eroding headwater of the Right Fork of Mid-



HEADWATERS OF LICKING.

This mountain view showing typical Eastern Coal Field topography is at the mouth of Grassy Branch in Magoffin County.

dle Creek, a southeast flowing tributary of the Big Sandy, in an almost classical Pleistocene and Recent piracy induced by structural advantage, has captured the upper reaches of Burning Fork of Licking River. Salyersville, the county seat, has an elevation of 875 feet, but the ridges in the immediate vicinity rise to 1,200 and 1,300 feet; while in the southern part of the county the summit elevations of the hills—steep sloped and forested—give figure at altitudes of about 1,650 feet to the well defined and maturely dissected Cumberland Plateau.

The hard rocks of Magoffin County consist of a sequence of sandstones, sandstone conglomerates, sandy shales, shales, thin impure fossiliferous limestones and coals, principally of the Pottsville series (Pennsylvanian). There are, however, a few outliers of the Allegheny capping the boundary ridges of this

district on the west, south and southeast. Brown quartzitic pebbles and boulders ranging in weight from a few pounds up to about 100 pounds, carrying *Scolithus* borings and sourced from Cambrian ledges in the "Smoky" district of western North Carolina, are not infrequently found throughout the main Licking valley. These erosion resisting metamorphics are the last remnants of Lower Cretaceous fluviatile deposits accreditable to the formerly through-flowing Big Sandy River. Much evidence of Pleistocene and Recent dissection is seen on the upper waters of the Licking River. The flood plain deposits are composed of sands, clays and gravels of Pleistocene and Recent age.

The structural geology of Magoffin County is broadly described as consisting of a faulted and flexed arch—the Paint Creek Uplift. Regional dips, except for this pronounced north and south structure, are to the south and southeast into the Eastern Kentucky Geo-syncline which passes through the southern reaches of the county over the waters of Trace Fork and Licking River. The northern tip of Magoffin County is faulted by the Irvine-Paint Creek Fault, this normal fracture giving evidence of a displacement ranging from 40 to 120 feet, and striking generally east 5 degrees south along the waters of Rockhouse Creek. About seven miles to the southeast the Johnson Creek normal fault, exhibiting a throw ranging from 60 feet to 140 feet, roughly parallels the Irvine-Paint Creek Fault on the north, striking east about 5 degrees north from the headwaters of the State Road Fork of Johnson Creek on the west to the head of the State Road Fork of Licking River near Falcon on the east. The axis of the Paint Creek Uplift, the most conspicuous north-south structure of Eastern Kentucky, follows generally the eastern boundary of Magoffin County from the head of Raccoon Creek to the upper waters of Middle Creek. There is exhibited by this structural feature within the boundaries of Magoffin County from Ticklick Branch to Pricey Creek a reversal to the west of 260 feet, establishing for this district in the Mine Fork Dome, the highest closed structure of the Eastern Kentucky Coal Field.

The leading mineral resources of Magoffin County are oil and gas, bituminous and cannel coal. The principal oil and gas sands are the "Maxon," "Wier" and "Berea" (Mississippian),

the "Wier" alone being accountable for the large high gravity petroleum production of recent years which during the year 1922 amounted to 1,234,372.71 barrels, valued at \$2,530,691.06. The "Maxon" (Mauch Chunk) sand has produced very considerable amounts of natural gas, as has also the "Wier" and "Berea" (Waverly); while the "Berea" sand is an oil producer of third rate importance. A shallow Pottsville sand, possibly the "Beaver," in the vicinity of Ivyton, has produced some heavy black oil. The coals of Magoffin County are only available for export in the southern part of this district, but during the year 1925 witnessed the production of 114,706 tons.

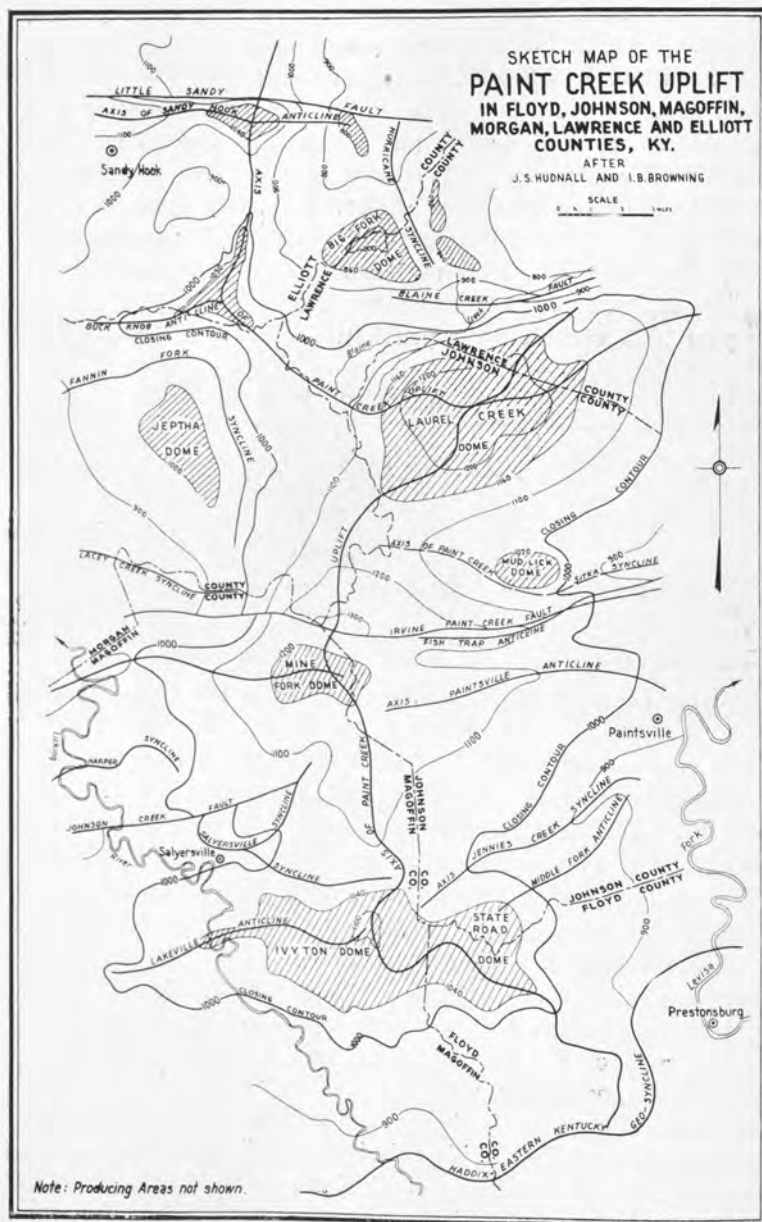


MASTODON TOOTH FROM BURNING FORK.

This typical Pleistocene vertebrate fossil was found in April, 1928, by Dewy Pace on the farm of Dola Pace on the head of Beartree Fork of Rockhouse Creek 8 miles southeast of Salyersville in stream alluvium. K. Z. Wilkins, of Lexington, presented it to the State of Kentucky.

Some excellent deposits of cannel coals are found in Magoffin County, but being located mostly in the vicinity of Bloomington, are not so situated with respect to rail transportation as to be of commercial importance at the present time. Alluvial clays in the Licking River flood plain might be used for ordinary brick-making, as could some residual clay shales. Sands and gravels in the Licking Valley are used for general building construction.

An oil and gas structural map (1921), scale 1 inch equals one mile, is available of Magoffin County; and the most important producing area in this district is also shown on the regional map of the Paint Creek Uplift (1924), scale 1 inch equals 1 mile, contoured with 10 foot intervals on the Fire Clay coal. The topography is shown on the Salyersville Sheet, scale 1:125,000, and the Paintsville, Hindman, and Prestonburg sheets, scale 1:62,500. A detailed geological report on the stratigraphy and economic resources of Magoffin County was published in 1918 by the Kentucky Geological Survey, but is now out of print.



LXXV.

MARION COUNTY.

Marion County is situated in central Kentucky on the upper waters of Rolling Fork of Salt River. It encompasses about 345 square miles. The northern part of the county is encompassed within the Outer Bluegrass, while the Knobs Belt traverses the



A BLUEGRASS PIKE IN MARION COUNTY.

central portion of the county along a generally east and west line. The southern and southwestern part of Marion County is embraced within the Pennyroyal Plateau. Lebanon, the county seat, with an elevation of 775 feet, is representative of the Outer Bluegrass Plain, while to the south Muldraugh's Hill, an erosional scarp of pronounced figure following the Devonian-Mississippian outcrop which strikes slightly south of west across the county, rises 300 feet above the Outer Bluegrass Plain.

The rocks of Marion County consist of a sequence of Paleozoic sediments ranging from the upper part of the Cincinnati (Ordovician) through the Silurian, Devonian and entire Mississippian series. Superimposed upon these sediments disintegrated remnants of the Pottsville conglomerate (Pennsylvanian) occur on the dividing ridge at the corner of Larue, Taylor and Marion counties. These sediments are the highest in the stratigraphic

column in this region. Transported sands and gravels of recent and Pleistocene age occur in the flood plains and channels of the Rolling Fork of Salt River and its principal local tributaries.

The structural geology of Marion County in figure is a southwestward dipping monocline. Regionally this county is located on the southern flank of the Lexington Dome of the Cincinnati Arch. It is bisected along a line of a strike 5 degrees south of west by the Mitchelsburg Fault, which exhibits a small normal displacement, but is coupled with high angles of flexure on the south producing great structural variation within short horizontal distances. A few miles south of Lebanon another line of alternating faults and anticlines paralleling the disturbance referred to above are known to be in occurrence.

The leading mineral resource of Marion County is limestone which occurs in quality and quantity sufficient for highway, railway bed, and general building construction as well as for medium grades of agricultural lime. Some of these limestones might be used in cement manufacture, and many of the ledges are suitable for use in concrete construction. Residual clays are available for brick-making. Creek and river gravels are used to some extent in the surfacing of secondary roads. The outcrop of the Chattanooga (Devonian) black shale presents unlimited supplies of oil-bearing rocks suitable for producing artificial petroleum at some future time should this resource be needed.

A colored geological map of Marion County, prepared by the Second Geological Survey, is available at the scale of 1 inch to the mile. A colored structural geological section projected southeastwardly through the vicinity of Bradfordsville is shown on this map. A new areal geological map of Marion County, scaled one inch equals one mile, is now being surveyed and will be available early in 1929. The area has not been surveyed topographically.

LXXVI.

MARSHALL COUNTY.

Marshall County is situated in the Jackson Purchase Region in western Kentucky. It is bounded on the north and east by the lower waters of the Tennessee River, into which all of the local drainage falls, with the exception of the western part of the county which is drained by the East and West Forks of Clarks River. Areally it covers about 327 square miles. The upland terrain of Marshall County remote from incised drain-



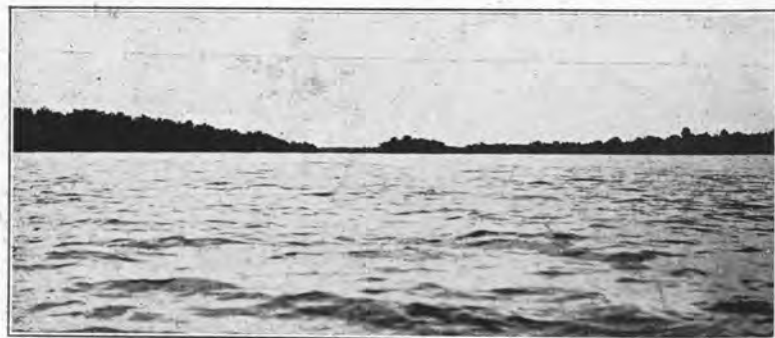
EAST FORK OF CLARKS RIVER.

In this panorama near Benton the topography ranges from undulatory to low flat hills of dissection.

age channels is only slightly undulatory. This plain dipping slowly to the north, breaks somewhat sharply into the lower waters of Bear and Jonathan creeks, tributaries to the Tennessee River along the eastern border. A similar hilly and sharply contoured topography borders either side of the East Fork of Clarks River in the western part of the county. The Tennessee River exhibits a rather narrow Recent flood plain, above which, about 30 feet, an older terraced flood plain stretches back a mile or two and merges into the lowest hills. This abandoned fluvial plain rising from 340 feet on the north to 350 feet upstream may also be seen as one ascends Clarks River. Benton, the county seat, with an elevation of 375 feet is representative of the Valley interior of the district, but uplands surrounding rise 450

feet above sea level, while elevations of about 525 feet occur near Hardin at the Calloway County line on the south. Minimum elevations of about 325 feet are found on the Tennessee River flood plain near the McCracken County line, thus indicating a maximum relief in the district of 200 feet.

The rocks of Marshall County are for the most part unconsolidated sands, gravels, clays and lignites of Cretaceous, Eocene, Pliocene, Pleistocene, and Recent age. Older formations than these occur, however, on the lower waters of Jonathan and Bear creeks, and the Tennessee River. Here erosion has revealed re-



TENNESSEE RIVER NEAR HILLMAN FERRY

There are a number of grass and timber islands in the wide river at this point.

stricted outcrops of Meramec (Middle Mississippian) limestones principally referable to the St. Louis. This belt of hard calcareous Paleozoic sediments ranges from two to six miles in width due to the variability in areal extent of the superimposed unconsolidated outliers. Given in sequence above these Mississippian limestones, there are the Cretaceous gravels of Tuscaloosa and Eutaw age, and the overlying Ripley micaceous sands and clays. These occur as more or less restricted deposits just above the Carboniferous limestones on the waters of Jonathan and Cypress creeks, and also on the headwaters of East Fork of the Clarks River where dissection through overlying Tertiary beds, has brought them to the surface. The Eocene deposits consisting of the Porter's Creek clay, and the LaGrange sands, clays and lignites, coupled with the overlying LaFayette (Pliocene) reddish sands and gravels, are grouped together in the south-

western part of the district, though the LaFayette extends east of Clarks River and is found as outliers resting upon the Cretaceous. Pleistocene alluviums and loess compose the broad abandoned terraces and second bottoms of the Tennessee and Clarks rivers, while Recent sands, silts and clays make up the first or inner river bottoms.

The structural geology of Marshall County is not readily nor accurately interpretable in detail due to the fact that the unconsolidated, Cretaceous, and Tertiary deposits have effectually blanketed dependable outcrop criteria in the field. Generally, however, the Paleozoic floor underlying the county is recognized to be a monocline dipping at the rate of about 35 to 45 feet to the mile to the southwest, this inclination being due to the county's location on the western slope of the Kuttawa Arch. The Paleozoic platform beneath the cover of surface unconsolidated sediments is assumed to be considerably faulted, the general pattern being held to be quite similar to that of Lyon, Livingston, and Trigg counties on the northeast in which districts a radical complex of normal faults ranging from north 80 degrees east to north 85 degrees east has been definitely established by detailed work in the field.

The principal mineral resources of Marshall County are sands, clays, and gravels. Sands occur as both transported and residual deposits suitable for general building construction. Gravels of Cretaceous age are available for highway, railway, and concrete construction. Clays suitable for ordinary brick making, as well as for the more specialized uses required in pottery and stoneware work, are present. The best producing horizon appears to be the Porter's Creek formation (Eocene). Shallow well water is used for domestic purposes to a very large extent.

A geographic map of Marshall County published during 1928 is available, scale one inch equals one mile. The topography as well as the detailed geology of the northern part of the county covering the area embraced in the Smithland Quadrangle has been executed by the Kentucky Geological Survey and has been published at the field scale of 1:48,000.

LXXVII.

MARTIN COUNTY.

Martin County, situated in the Mountain Region of Eastern Kentucky adjoining the State of West Virginia, is drained by the Tug Fork of Big Sandy and its principal local tributaries, Wolfe and Rockcastle creeks and their branches. It covers an area of 227 square miles. The district is extremely hilly



HEAD OF PIGEON ROOST CREEK.

All of the upland topography in Martin County is similar to that shown here. All the dwellings and most of the tilled land follow close to the creeks.

throughout, being typical of the medial interior of the Cumberland Plateau. The ridges are steep, forested and winding, while the valley bottoms are restricted in size, narrow and meandering. Inez, the county seat, has an elevation of 630 feet, but ridges in the vicinity of Inez rise to 1,150 feet, while uplands bounding the headwaters of Wolfe and Rockcastle creeks, adjoining Floyd and Pike counties, attain elevations ranging from 1,400 feet to 1,500 feet. Both Tertiary and Pleistocene dissection are accountable for the very considerable relief found throughout this district. A minimum elevation of 600 feet on the Tug River flood plain at the Lawrence County line gives datum for the calculation of a maximum relief over the entire district of 900 feet.

The rocks of Martin County—sandstones, sandstone conglomerates, sandy shales, shales, and coals—are referable entirely to the Coal Measures (Pennsylvanian). With the exception of a general distribution of outliers of the Allegheny capping the higher ridges, in the southern and northern parts of the county, the surface consolidated beds in this district fall within the Pottsville series. The flood plain of the Tug Fork and the lower waters of its branches contain unconsolidated sands, gravels, clays, and silts of Recent and Pleistocene age.

The surface structural aspect of Martin County is broadly anticlinal, specifically a two-pronged, broken, plunging arch known as the Inez-Warfield Anticline which stretches into the district from West Virginia on the east and is met by the Paintsville and Grassy Gap anticlines reaching into the county from the west producing a low anticlinal saddle on the upper waters of Rockcastle Creek. The southern flank of the Warfield component of this conspicuous arch is broken by the Warfield Fault, a normal fracture widely recognized throughout West Virginia as associated with the Chestnut Ridge disturbance extending many miles northeastward into Pennsylvania. The displacement along the Warfield Fault in Kentucky varies from 25 feet to 125 feet. It is readily seen in the Tug Fork valley about a mile above Kermit.

The subsurface structure (Big Lime-Mississippian) is in effect a somewhat intensified reproduction of that seen at the surface and mapped on the structure (Fire Clay Coal—Pottsville). Anticlines and synclines indicated by the Coal Measures are somewhat heightened in angle on the lower datum due to two factors: (1) thickening of the Coal Measure sequence to the southeast, and (2) pre-Pennsylvanian folding of low angle along similar axes to those occurring in the Coal Measures. As mapped on the top of the Big Lime the Paintsville Anticline extends eastward as far as the headwaters of Little Elk Creek with well defined doming closure two miles south of Inez. The south flank of the Warfield Anticline becomes greatly steepened exhibiting dips of 125 feet to the mile immediately south of the Warfield Fault. Another outstanding feature on the lower structural platform is the Long Branch Dome which appears with closure of about 75 feet near Naugatuck.

The normal regional dip of both surface and subsurface measures in the northern part of the county is to the north into the northeastern geo-syncline of Kentucky so evident in Lawrence County. South of the Warfield Anticline, the regional dip of the surface beds is to the southeast into the Eastern Kentucky Geo-syncline which passes through central southern Martin County along a line of strike north 50 degrees east, following



WARFIELD FAULT ON TUG RIVER.

somewhat generally the main waters of Wolfe Creek which is in effect surficial geo-synclinal drainage. The sub-surface Mississippian, Devonian, and lower Paleozoic Measures fail to indicate the presence of a local geo-syncline, and with ever steepening angles of dip plunge successively southeastward under the southern central Appalachian Coal Field.

The leading mineral resources of Martin County are bituminous coal and natural gas. In this district out of a series of about twelve coals, the following are the most important: Warfield, Williamson, Fire Clay, Winifrede, Buffalo Creek, Peach Orchard, Broas, and Richardson. During the year 1925 there were 438,076 tons of coal produced and exported from Martin County. This district composes one of the oldest and most important natural gas fields of Kentucky, the producing area being designated as the Inez Gas Field, which extends from the vicinity of Kermit in West Virginia westward throughout the heart

of central eastern Martin County. Commercial quantities of natural gas are produced at depths ranging from 750 to 1,500 feet, principally from the Salt (Pennsylvanian) Maxon, Big Lime, Big Injun and Berea (Mississippian) "sands." The Ohio shale and the Corniferous (Devonian) limestone are also productive of natural gas, but up to the present have been rather infrequently drilled. Natural gas development began in Martin County in 1881. In the peak year 1914 open flow measurements from 92 wells in Martin County amounted to a daily 90,000M cubic feet, and maximum deliveries of 18,000M cubic feet per day were being made. This large gas production was then utilized by several public utilities lines, particularly those extending to Lexington, Louisville, Ashland and Cincinnati, and other cities. Natural gas is still being delivered to these lines from Martin County wells, but in somewhat decreased amounts. Oil has been secured in commercial quantity in one or two indexing wells in this county, but has never been commercialized, due to the importance of the region as a gas producing district. Carbon ratio is shown by coals and ranges about 60 per cent.

Transported sands suitable for general construction purposes are available from some flood plain deposits of the Tug River, and also from channel deposits of Rockcastle and Wolfe creeks.

A surface structural map (1923) keyed on the Fire Clay coal, with 10 foot contour intervals, and a subsurface structural map (1924) keyed on the top of the Big Lime, with 10 foot contour, are available. The district has been surveyed topographically on the Inez, Naugatuck, and Harold quadrangles, scale 1:62,500. The geology and mineral resources of this county have been described by the Kentucky Geological Survey in a number of separate reports—no unit county report of Martin County having been prepared.

LXXVIII.

MASON COUNTY.

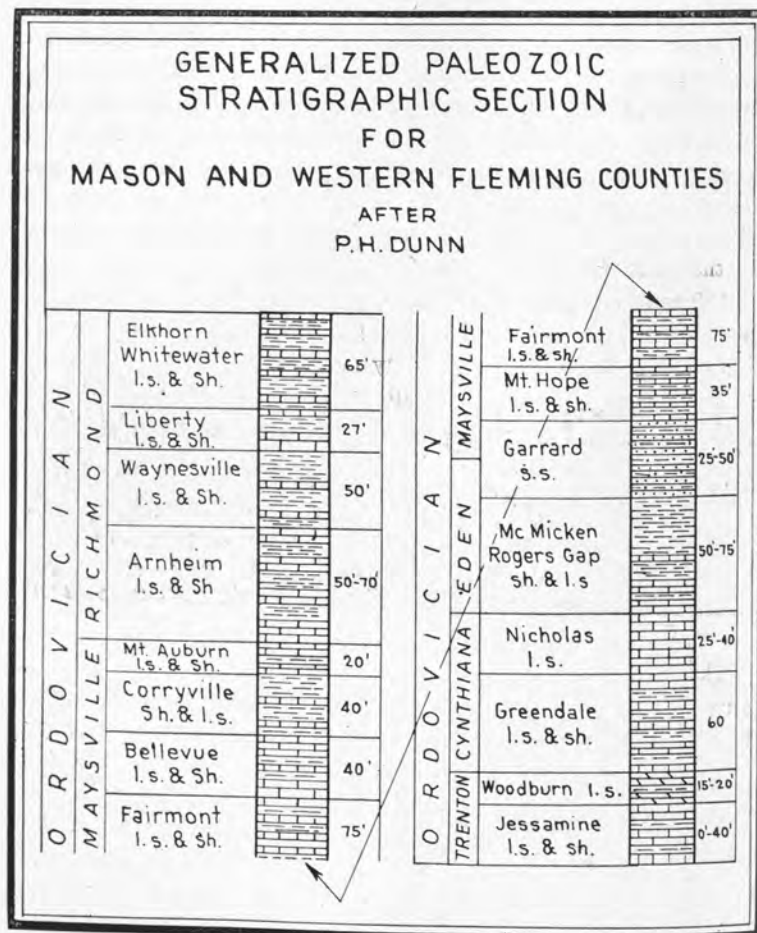
Mason County is situated in northern Kentucky adjacent to the Ohio River and the State of Ohio. Areally it covers 239.09 square miles. The drainage of the northern part of this district falls rapidly into the Ohio, while the North Fork of Licking River drains westwardly more slowly the southern part of the county, which is typically a part of the Outer Bluegrass of Kentucky. The central and southern parts of the county



OHIO RIVER VALLEY AT MAYSVILLE

are undulatory to rolling, their headwaters streams throughout exhibiting only the lowest of gradients. This upland portion of Mason County is still essentially a Tertiary plain undissected in any considerable amount until one enters the inner valley of the North Fork of Licking River below Lewisburg (466 feet) and approaches the Bracken and Robertson County lines. A very great contrast topographically to this inland county is evidenced, however, as one nears the Ohio River northward bound. Here late Pleistocene dissection has resulted in immediate relief of 300 feet. Maysville has an elevation of 524 feet, while the uplands of Mason County in the vicinity of Washington, Dimmit, and Helena rise to elevations of 850 and 900 feet, giving a regional maximum relief of about 375 feet for the entire district.

The hard rocks of Mason County consist of limestones, sandstones, and shales of the Cincinnati (Ordovician) and Silurian divisions of the Paleozoic. Occasional small Pleistocene (Canadian) igneous and metamorphosed erratics are found in



SECTION FOR MASON AND FLEMING

this region, evidently sourced from glacial outwash or ponding, while the flood plain of the Ohio River reveals a sequence of unconsolidated alluvial sediments of Pleistocene and Recent age. The structure of Mason County is essentially that of a north-

eastward dipping monocline flexed by a number of minor anticlines and synclines of fingering type, but unfaulted so far as is known.

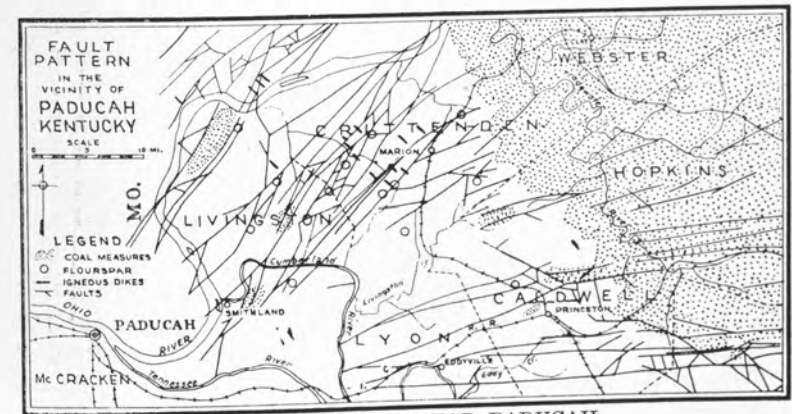
The leading mineral resource of Mason County is limestone, which is produced in quality and quantity suitable for regional building construction. It is also used as a road material, railroad ballast, and for concrete construction. Some grades of Mason County limestone when combined with proper clays might be used for cement making purposes, and others are high enough in their calcareous content to be suitable for agricultural lime. Sands and gravels are dredged from the bed of the Kentucky River for general constructional purposes. Transported clays occurring in the bottoms of the Ohio River are used for brick manufacture in Maysville. Residual upland clays sourced from Ordovician and Silurian limestones might also be used in making common brick and tile.

A geographic map (1926) of Mason County, scale 1 inch equals 1 mile, is available from the Kentucky Geological Survey. A soil map of the same scale was prepared by the U. S. Department of Agriculture in 1903.

LXXIX.

McCRACKEN COUNTY.

McCracken County is situated in the northern part of the Jackson Purchase Region adjoining the Ohio and Tennessee rivers and the State of Illinois. It covers 264.38 square miles. The drainage of the northern, central and eastern parts of the county falls into the Tennessee and Ohio through Clarks River and other local north-flowing tributaries, the most important of which are Island and Massac creeks. The southwestern por-



FAULT PATTERN NEAR PADUCAH.

tion of this district is drained by Mayfield Creek, a westward flowing tributary of the Mississippi River. Paducah, situated on the abandoned Pleistocene flood plain of the Ohio River, has an elevation of 341 feet, but low rolling uplands to the south and southwest rise to about 490 feet on the divide between the Ohio drainage and Mayfield Creek. A minimum elevation of 315 feet occurs along the Ohio River near the Ballard County line, giving a maximum relief for the entire district of 175 feet.

The rocks of McCracken County are all unconsolidated sands, gravels, clays, and lignites of Cretaceous, Eocene, Pliocene, Pleistocene, and Recent age. The Cretaceous gravels occur in outcrop principally in the northern part of the county on the

lower waters of Clarks River and the adjacent waters of the Tennessee. These gravels are referable chiefly to the Tuscaloosa and Ripley formations. Superimposed upon them there occur in ascending order, as one progresses to the southwest, the Porter's Creek and LaGrange formations (Eocene), and the Lafayette formation (Pliocene). Terraced loess (Pleistocene) occurs on the old and abandoned flood plains while sands, gravels, clays and silts of Recent age make up the present inner flood plains of the western streams.

The structural geology of McCracken County is indefinite in detail, due to the broad mantle of unconsolidated materials appearing at the surface. It is assumed to be highly faulted in a somewhat radial pattern centering towards northern Graves County, as indicated by the fault pattern of the Paleozoic rocks surrounding this northern tip of the Old Gulf Embayment. A number of wells, drilled for both oil and water in the vicinity of Paducah, have encountered Mississippian limestones at varying depths within short horizontal distances, indicating a considerable subsurface displacement or angular relief in the Paleozoic platform underlying this district.

The leading mineral resource of McCracken County is clay, which is produced for brick, tile and pottery purposes from residual deposits in the Porter's Creek formation (Eocene) as well as from alluvial clays (Pleistocene) adjoining the Ohio and Tennessee. Gravels suitable for road construction are available both as residual (Cretaceous) and stream channel deposits (Recent) for road and concrete construction, and are widely used. A small amount of spring water is used for domestic purposes in this district, but ground water at depths ranging from 50 to 150 feet is much more reliable.

A geographic map (1927) of McCracken County, scale 1 inch equals 1 mile, is available, and the topography for the northeastern portion of this district has been presented on the Joppa, Paducah, and Smithland sheets, scale 1:62,500, with 20 foot contour interval.

LXXX.

McCREARY COUNTY.

McCreary County is situated in southeastern Kentucky adjacent to the State of Tennessee. It contains 453.2 square miles. The district is mountainous throughout, being typically so in the southeastern portion and throughout quite representative of this portion of the Cumberland Plateau. Central and



CUMBERLAND FALLS FORD AT LOW WATER.

southeastern McCreary County exhibits steep-sided, forested, winding ridges with narrow meandering valleys. Northwestern McCreary County presents, in contrast, precipitous relief along the gorge of the main Cumberland River from the Cumberland Falls northwestward to the Pulaski County line. A somewhat similar relief, though not quite as considerable, is found in western McCreary County along the lower South Fork of the Cumberland River. Whitley City, located on the dividing ridge between the Main and South Forks of the Cumberland River, has an elevation of 1,317 feet, the highest of any county seat in Kentucky, but ridges in the southeastern part of the county rise to 2,200 feet, while a minimum elevation of about 650 feet at the

mouth of Beaver Creek gives datum for a maximum physical relief of 1,550 feet for the entire district. Local relief averages about 400 or 450 feet.

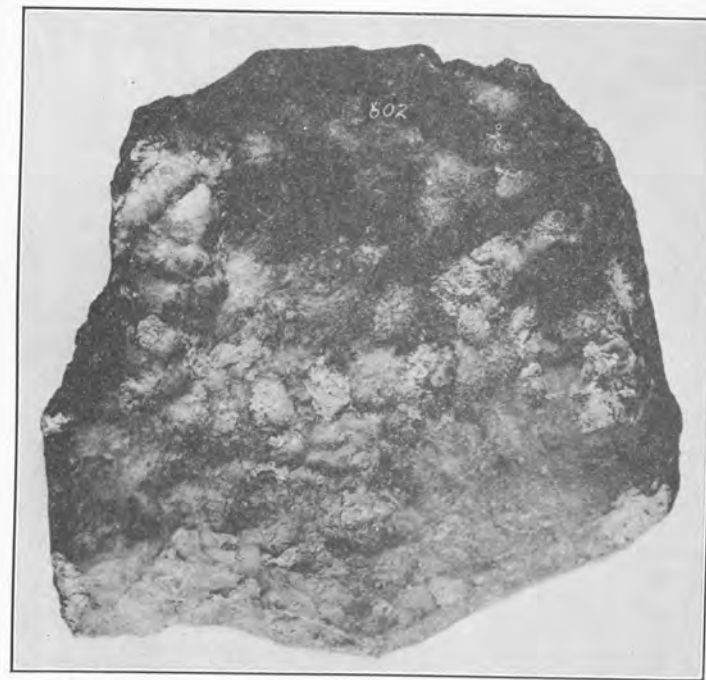
The hard rocks of McCreary County consist of a sequence of limestones, sandstones, sandstone conglomerates, shales and coals, all of Carboniferous age. Along the lower waters of the South Fork of the Cumberland River, St. Louis limestones, representatives of the Meramec (Mississippian), are on outcrop and



CUMBERLAND RIVER FALLS.
It is Kentucky's greatest cataract though hardly sixty feet in height. Pottsville sandstones support it. Considerable undeveloped hydroelectric power exists here.

the same is true to a considerable distance up the Little South Fork between Wayne and McCreary counties. On the lower waters of the North or Main Fork of the Cumberland River, Chester limestones reach headward to the vicinity of the mouth of Rockcastle River, and on the South Fork these same formations extend headward to and beyond the Tennessee line. Superimposed somewhat above these calcareous formations and separated from them by the soft red and green Pennington shale (Mississippian) and some Coal Measure elastics, the Lee conglomerate sandstone (basal Pottsville-Pennsylvanian) is conspicuous as a great cliff-forming member throughout the county. This is the formation which, resting on the softer underlying Pennsylvanian shales and sandstones, produces the far famed and majestic Cumberland Falls. No Paleozoic sediments younger

than the Pottsville are known to occur in McCreary County. Along the lower waters of the South Fork and in restricted areas in the narrow flood plain of the Main Fork of Cumberland River, late Pleistocene and Recent alluviums are present. The entire sequence of Carboniferous rocks in this district is about 1,250 feet in thickness.



"CUMBERLAND FALLS" METEORITE.
This is one of a number of complete individuals. It weighed 2347 grams.

The surface structure of McCreary County is in effect an eastward dipping monocline flexed by numerous anticlines and synclines, chiefly of low plunging figure. Two well defined domes of small areal extent but adequate closure are located in the western part of the county at and somewhat southeast of Paint Cliff. The district, though closely adjacent to the Pine Mountain overthrust fault on the southeast, is unfaulted and apparently but slightly deformed by flexing.

The most important mineral resource of McCreary County is bituminous coal, which occurs in commercial quantities widely distributed throughout this district. In a sequence of about eight coals, the following are the most important commercially: No. 1 (Hudson), No. 1½ (Hudson Rider), No. 2 (Beaver Creek), No. 3 (Barren Fork), and No. 4 (Lily). The Upper and Lower Blue Gem coals (Nos. 5 and 6), and the Jellico Seam (No. 7) are also present, but are not operated for export. The Hudson and Beaver Creek coals are interconglomeratic stratigraphically and are of excellent character. In 1925, there were 887,769 tons of coal produced and exported from McCreary County. Small pools of oil and gas have been developed in this district, particularly in western McCreary County near Slavans and White Oak where the well known and productive Beaver sand (Mississippian) of Wayne County is present and has been somewhat developed.

Limestone suitable for building construction and for use as highway metal and railroad ballast occurs in the valley of the South Fork. Some ledges of this limestone, high in calcareous content, might be used for agricultural lime, and others combined with proper clays would be suitable for Portland cement manufacture. Sands of good character, acceptable for general construction, and gravels for highway and general building purposes, are available both as transported and disintegrated residual deposits.

A detailed geological structural oil, gas, and mining map of this district was prepared in colors by the Kentucky Geological Survey and issued in 1928. The topography of the eastern portion of this area is available on the Williamsburg Sheet, scale 1:125,000. That of the district drained by the South Fork of the Cumberland River on the west has been surveyed during this year on the Burnside and Barthell quadrangles, and is available, at the field scale of 1:48,000, in preliminary photolithographs.

LXXXI.

McLEAN COUNTY

McLean County is situated in the heart of the Western Kentucky Coal Field. It embraces about 253 square miles. The district is one distinguished by low rolling hills intercepted by the lower waters of the Green and Pond rivers, both of which



A GREEN RIVER MEANDER IN McLEAN.

There are long stretches along this stream in the central interior of the Western Coal Field where cliffs and high uplands are totally absent. The view here is just east of Pond River.

are broadly alluviated at elevations ranging from 380 to 400 feet. The wide flood plains of this region include many areas of marsh lands, some of which are unfit for general agricultural purposes until drained. The maximum relief of the county is about 290 feet; the highest hills slightly southwest of Beech Grove rise to about 650 feet, while the lowest elevation, 360 feet, is found where the Green River passes out of McLean County at Delaware. Calhoun, the county seat, has an elevation of 392 feet above sea level.

The hard rocks of McLean County are all of Pennsylvanian age. They consist of sandstones, shales, coals and thin limestones and are found in alternating stratigraphic sequence, being referable to the Pottsville, Allegheny and Conemaugh formations. The lacustrine and fluvial alluvial deposits—sands, silts, clays and gravels covering the broad bottoms—are both Pleistocene and Recent. The structure of McLean County is

geo-synclinal, the district being located in the lowest part of the trough of the Western Kentucky Coal Field. Along the northern boundary within the county the Rough Creek disturbance, an intermittent faulted and folded structure of major significance, strikes slightly north of west from the Ohio County line through the vicinity of Buel, Glenville, and Beech Grove. This disturbance presents both overthrust and normal faulting with much high angle folding. Forty-five and 50 degree dips are not uncommon. The rocks of the county are also disturbed by the Livermore Fault along and just south of the Green River. This normal disturbance strikes southeastwardly across the Webster



GREEN RIVER FERRY AT CALHOUN.

County line in the vicinity north of Ashbyburg and continuing uninterruptedly with a displacement 150 to 200 feet crosses Green River just south of Livermore. A fault of similar importance is the Curdsville, which follows the Green River on the northwestern boundary of the county. Several other minor faults, such as the Cypress Creek break, occur in McLean County.

The most important developed mineral resource of McLean County is bituminous coal, which occurs in commercial quantity widely distributed throughout the district. In 1925 a total of 76,829 tons of coal was produced for export. In a sequence of several recognizable beds, the No. 9 seam is the most important commercially, five considerable mining operations center-

ing about the town of Island. McLean County has produced some petroleum from shallow wells in the vicinity of Beech Grove, and recent development between Buel and Utica on the north side of the Rough Creek disturbance has brought about oil production in much larger quantities from deeper, probably Upper Mississippian sands. The bringing in of this new production may be taken to indicate a rather considerable undeveloped oil and gas field in northern McLean County. Clays and clay shales suitable for brickmaking occur both as alluvial and residual deposits.

McLean County was mapped geographically in 1920 to the scale of 1 inch equals 1 mile; and the topography for the district is available on the Calhoun, Sutherland, Central City and Madisonville quadrangles all scaled 1:62,500.

LXXXII.

MEADE COUNTY

Meade County is located in northwestern Kentucky adjacent to the Ohio River and State of Indiana. Areally it contains about 301 square miles. It is the northern extremity of the Pennyroyal district in western Kentucky. Brandenburg, the county seat, is an old Ohio River town, and has an elevation of 451 feet, but hill lands to the south and southwest rise to 900 and 950



BIG SPRING VALLEY IN MEADE.

The surface rocks are all of Chester age, principally limestones of high purity. Springs, caverns and sinks abound. The topography seen here is characteristic.

feet. The terrain is marked by alternating broad cultivated limestone valleys spotted by many sink holes, and circumscribing isolated hills and knobs generally in timber. Local relief ranges from 200 to 250 feet generally.

The hard rocks of Meade County are composed of Upper and Middle Mississippian limestones and shales, principally correlated with the Ste. Genevieve and St. Louis formations. Lower Subcarboniferous limestones appear below Garnettsville on Otter Creek. Clays and silts of Pleistocene or Recent age are found on the narrow flood plain of the Ohio River, and the lower waters of Otter Creek. The structure of Meade County is monoclinal, the normal dip being to the west from the Jessamine Dome of the Cincinnati Arch. The county is not faulted so far as is known, but there is one principal east and west fold—the Dry Valley Anticline—and a number of other flexures of probable economic importance, though of minor dimensions.

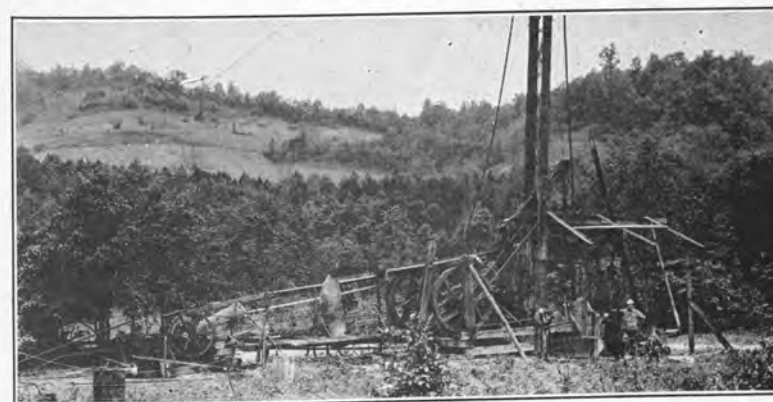
The principal mineral resource of Meade County is limestone, which is produced in commercial quantity and quality for all general purposes of highway and railroad bed construction as well as for building purposes. Large quantities of Meade County limestones are used for the manufacture of Portland cement, and much of this limestone is suitable for agricultural purposes as fertilizer. One of the important mineral resources of Meade County is natural gas, which is produced at Long Branch and Bartles in the vicinity of Rock Haven and Weldon, principally from the Chattanooga or New Albany (Devonian) black shale, at depths of 300 to 400 feet. This gas was first developed in about 1858, and it was finally commercialized in 1888, and has been transported through pipe lines to Louisville for many years. While the wells individually are not of large size, either in volume or rock pressure, their resource value is considerable because they possess long life. Salt was formerly produced from brines secured from drilled wells on Potters Creek two miles northeast of Rock Haven near the Ohio River.

The geology (with Breckinridge County) and the oil and gas development of Meade County were mapped to the scale of one inch equals two miles in 1891 on separate sheets by the Second Geological Survey. The district is partly surveyed topographically. That portion of western and central northern Meade County shown on the Hardinsburg and Corydon sheets was surveyed during the summer and fall of 1928 and is now available as photolithographs at the field scale of 1:48,000. In addition a small area involving the Federal Camp Knox Military grounds has been presented as large scale topography for army purposes.

LXXXIII.

MENIFEE COUNTY.

Menifee County, exhibiting an area of 224.70 square miles, is located on the western border of the Eastern Kentucky Coal Field. The district is rugged throughout, being characteristically clefted in the northwest and southwest. It is a part of the western border of the Cumberland Plateau, but it is not really mountainous. Frenchburg, the county seat, has an eleva-



OIL WELL DRILLING IN MENIFEE HILLS.

While much of the topography of Menifee County is rugged, there are many hills of gentle slope, particularly at points removed from the Pottsville conglomerate outcrop.

tion of 875 feet, but is surpassed by ridges to the southwest and southeast which rise to elevations of about 1,350 feet. The lowest altitude within the county is about 750 feet and is found on the Licking River near Yale at the Rowan County line. The maximum relief of Menifee County is therefore 600 feet, but local relief usually does not exceed 350 or 400 feet. The drainage all falls into the Red and the Licking rivers.

The hard rocks of Menifee County are all Paleozoic limestones, sandstones, and shales of the Carboniferous group, with the exception of a small area on East Fork where the Chattanooga (Devonian) shale appears at outcrop. Mississippian sediments cover the northern and western lowlands, while Lower

Pennsylvanian or true Coal Measure sediments are confined to the central and southeastern parts of the county. The structure of Menifee County is monoclinal, the normal dip being to the southeast at the rate of 30 feet to the mile. The regional structure is unfaulted so far as is known, but the measures are considerably flexed by fingering anticlines plunging southeastward away from the Jessamine Dome of the Cincinnati Arch.

The principal mineral resource of Menifee County is natural gas, which was developed in large quantities at depths ranging from 400 to 800 feet in a considerable number of wells southwest of Frenchburg and south of Rothwell in the vicinity of Fagan and Tabor. This gas field was opened up in 1904 and reached its maximum production during the years 1908 to 1910 with about 4,500,000 cubic feet daily delivered gas production. Beginning in 1911 the field declined rapidly. It has been utilized for domestic consumption in central Kentucky, and at the present time is regarded more in the light of an emergency reservoiring reserve than as an important contributor of natural gas. Oil in considerable quantities was developed in the Corniferous (Devonian) limestone in the vicinity of Maraba and Deniston in 1920, and other large areas adjoining await adequate prospecting.

The northern part of the county produces excellent limestone suitable for rural building, highway and railroad bed construction, while siliceous sands suitable for glassmaking and molding purposes are present in a number of localities. Residual gravels from the Pottsville formation are available for road-building and concrete construction, though generally at points somewhat removed from rail transportation. Outcrops of flint fire clays have been reported as occurring between the Mississippian limestones and the lowermost representatives of the Coal Measures but are not operated. The presence of these clays here suggests the possibility of important reserves of flint fire clays which may eventually be opened up for export.

Menifee County was mapped geologically in 1927 at the scale of 1 inch to the mile. The oil and gas development up to the present time has been delineated on this map. The southern portion of the county has been topographically surveyed on the Beattyville and Salyersville sheets, scale 1:125,000.

LXXXIV.

MERCER COUNTY

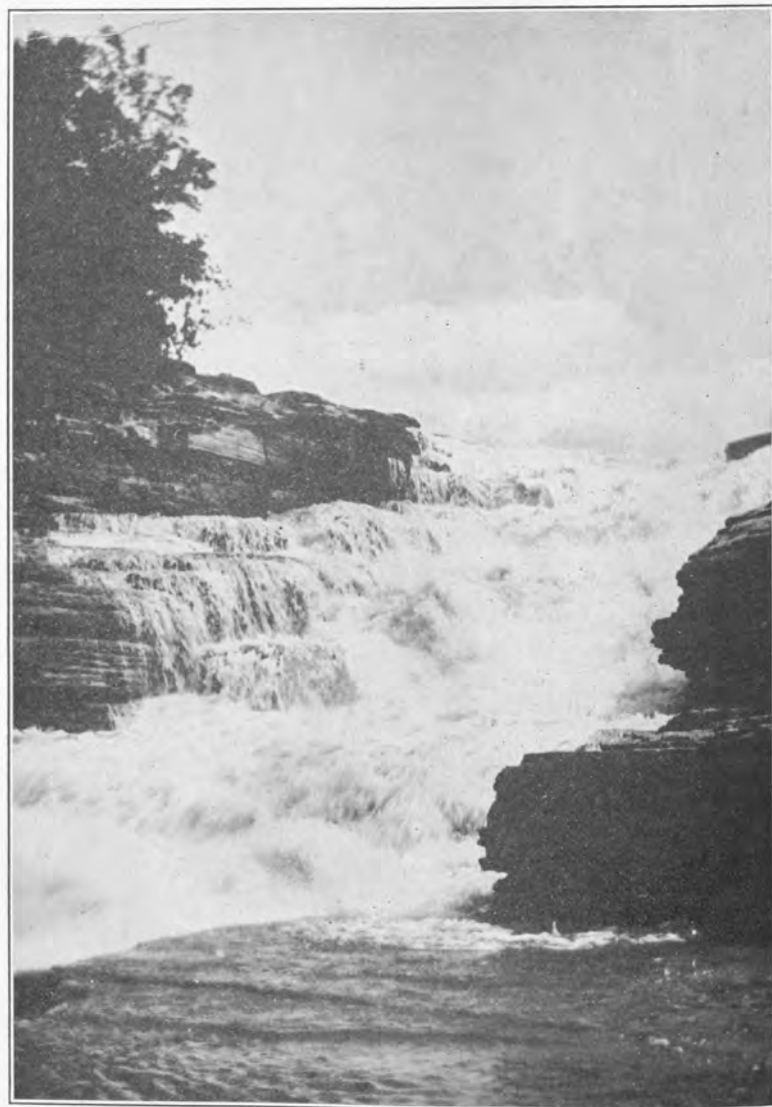
Mercer County is located in the southern central Bluegrass region. The area is a rolling to hilly limestone tableland comprising about 253 square miles. Harrodsburg, the county seat, with an elevation of 871 feet, situated on the headwaters of



OLD SHAKERTOWN.

This interesting village so close to High Bridge and Dix Dam is one of the landmarks of Mercer County. The building stones used in this dwelling were locally produced Tyrone (Ordovician) limestones.

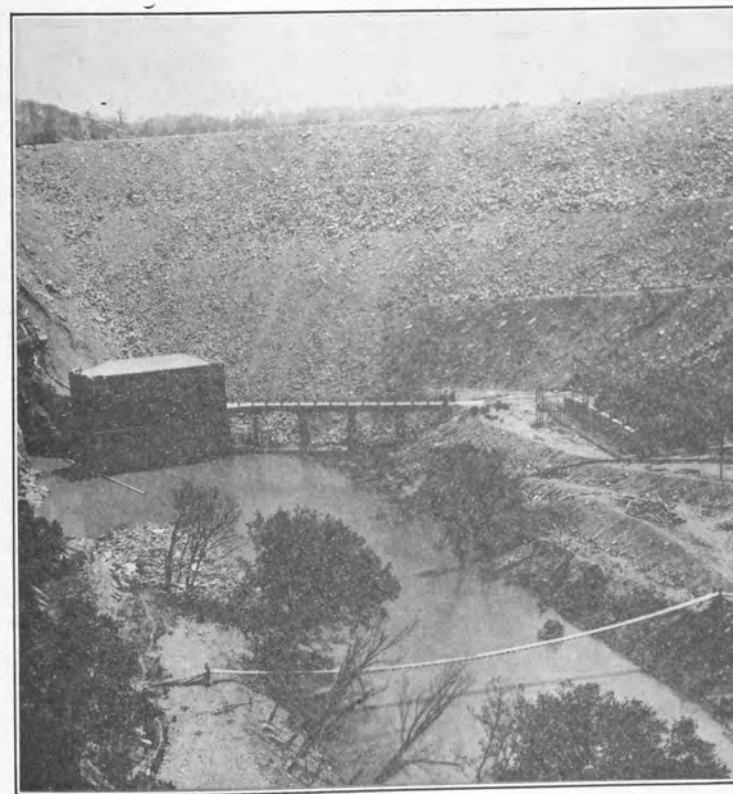
North Fork of Salt River, is representative of the upland portion of this district. Some ridges reaching up to about 925 feet are to be found, however, close to the Boyle County line on the south. Minimum elevations of about 500 feet occur in the gorge of the Kentucky River at the Franklin County line, giving a maximum physical relief for the entire district of 425 feet. Sharply clifted topography characterizes the eastern boundary of the county along the Kentucky and the Dix rivers, while west of the central plateau lie steep hill lands on the waters of Chaplin River in the vicinity of Duganville and Cornishville.



A NEW MERCER COUNTY WATERFALL.

This is the spillway at the Dix Dam in Mercer and Garrard counties. Sediments in point of active erosion are Ordovician limestones.

The hard rocks of Mercer County are all of Lower Ordovician age and consist of massive and thin bedded limestones and limy shales beginning with the Camp Nelson (High Bridge formation) and extending on up through the Eden shale forma-



DIX DAM AND POWER HOUSE.

The largest rock filled dam in the world, it spans the gorge of the former Dicks River, produces a lake of unique beauty, and besides affording hydro-electric power and light to Central Kentucky offers many features of interest to tens of thousands of travellers.

tion (Cincinnatian). The structure of Mercer County is monoclinal from a high point on the Jessamine Dome of the Cincinnati Arch, the normal dip being somewhat flat but inclined to the southwest at the rate of from 10 to 25 feet to the mile. While the county is not faulted, so far as is known, it is flexed by a number of minor anticlines and synclines.

The most important mineral resource is limestone, which occurs in abundant quantities for all necessary purposes of highway and railroad bed construction, as well as for rural and town building. Many of the limestones occurring in Mercer County are suitable when crushed for agricultural lime. Residual upland clays are available for ordinary brick making, and it is possible that field investigation might reveal beds of stoneware clay light gray in color similar to those found in Franklin County a few years ago near Farmdale, and others operated now in Madison County.

Mercer County was geologically mapped by the Second Geological Survey at the scale of one inch equals two miles. A new geographic map of Mercer County presenting a generalized stratigraphic section has recently been published at the scale of one inch equals one mile, by the Sixth Kentucky Geological Survey. The topography of more than 90% of this district has been delineated on the Harrodsburg Sheet, scale 1:125,000.

LXXXV.

METCALFE COUNTY.

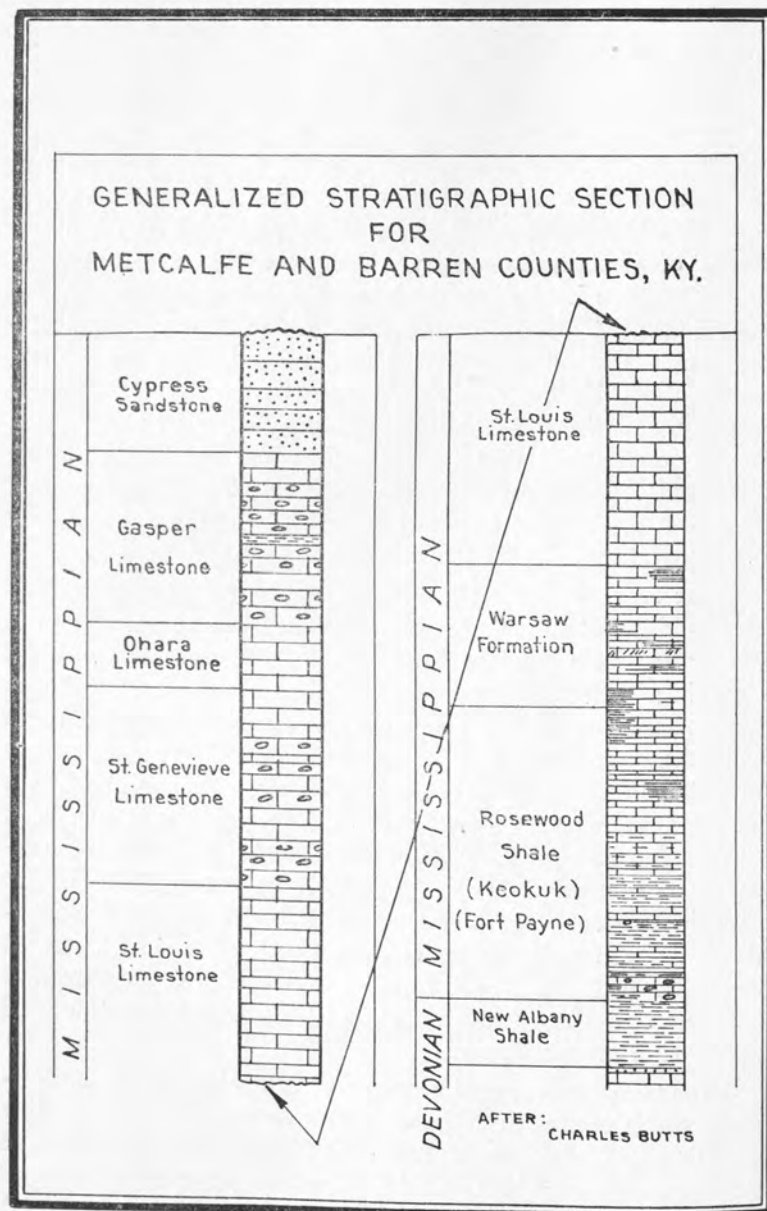
Metcalfe County is located in central southern Kentucky in the heart of the eastern Pennyroyal district. It covers an area of about 303 square miles. The county is drained by the upper waters of Little Barren River, Skeggs Creek of Big Barren River, and the headwaters of Marrowbone Creek, a southeastward flowing tributary of the Cumberland River. Physically the region is a rolling limestone plateau exhibiting many more or less isolated hills. Edmonton, the county seat, exhibits an elevation of 800 feet which is surpassed by low ridges and knobs in the central part of the county showing altitudes of about 1,000 feet. The northwestern part of the district has practically no surface drainage of importance. Sink holes are common, and the topography is best described as of the Karst variety.

The rocks of Metcalfe County consist principally of Mississippian limestones and shales. The St. Louis limestone covers the northwestern part of the district with occasional outliers extending farther to the east, while the eastern and southern parts of the county are given over to exposures of limestones and calcareous shales of the Warsaw, Fort Payne and New Providence formations of the Osage (Lower Mississippian). On the headwaters of Marrowbone Creek a small area has been etched more deeply than elsewhere and exposes the Chattanooga (Devonian) shale underlying, as well as some of the Upper Ordovician beds. The structure of Metcalfe County is monoclinal, the normal dip being slightly north of west at about 25 or 30 feet to the mile. A number of flexures of doming and fingering type plunge westwardly in the district, but faults of consequence are not known.

The principal mineral resource of Metcalfe County is limestone, which occurs in sufficient quantity and requisite quality for highway and railroad bed construction, as well as rural building purposes. Many of the limestones of Metcalfe County could be used to advantage as agricultural fertilizers. Residual upland clays are present suitable for ordinary brick making.

Oil and gas has been developed in small commercial quantities at a depth of about 500 feet in Metcalfe County, particularly in the district between Edmonton and the Hart County line. In the vicinity of Knob Lick and Three Springs a number of gas wells have been brought in indexing what is possibly an important shallow gas field. Production of both oil and gas is secured in the Corniferous (Devonian) limestones.

Metcalfe County was mapped geographically in 1924 to show oil and gas development, to the scale of one inch to the mile. No topography has been executed for this district.

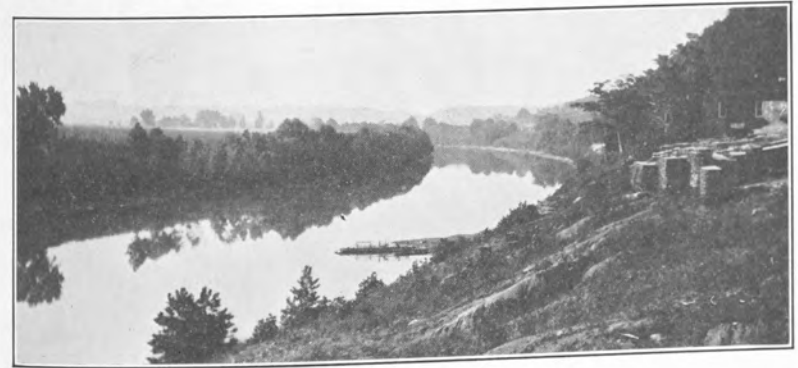


STRATIGRAPHIC SECTION: METCALFE AND BARREN.

LXXXVI.

MONROE COUNTY.

Monroe County is located in the southeastern part of the Pennyroyal district of Kentucky adjacent to the State of Tennessee. Areally it covers about 441 square miles. It is drained on the west by Indian Run and Long Fork, two headwaters



IN THE CUMBERLAND VALLEY.

Sharp meanders in the river are characteristic of this stream in Cumberland and Monroe counties. Note the ferry in the foreground—there are no bridges.

tributaries of the Barren River; while on the east minor drainage falls into the Cumberland River which bounds it. The district throughout is a maturely dissected plateau evidencing much subterranean drainage. Sinkholes are common, though not altogether continuous features of the surface. Tompkinsville, the county seat, has an elevation of 923 feet, but is exceeded in height by ridges both in the northern and southern parts of the county which rise to elevations ranging from 1,050 to 1,100 feet. White Hill, five miles southeast of Tompkinsville, is 1,147 feet above sea level. The lowest elevation, 545 feet, is found where the Cumberland River crosses the Kentucky line into Clay County, Tennessee, thus establishing a maximum relief for Monroe County of 602 feet. Only restricted areas of flat lands occur, these being confined to the alluviated bottoms of the Cumberland River.

The hard rocks of Monroe County consist of a sequence of Paleozoics beginning with Saluda sandstones (uppermost Ordovician) and extend up through the Devonian and the Lower Mississippian measures. A definitely recognizable part of the St. Louis (Middle Mississippian) limestone exists as outliers capping the higher hills of middle and western portions of the county. The Silurian is absent. Pleistocene and Recent alluviums are found along the Cumberland River. The normal structure of Monroe County is monoclinal, the dip being to the northwest from a high position on the Cincinnati Arch, the axis



A SIGNIFICANT OUTCROP IN MONROE.

The Saluda sandy limestone of Ordovician age is shown here underlying the Chattanooga (Devonian) black shale. All of the Silurian beds are missing, indicating a great disconformity in this part of Kentucky.

of which passes through the eastern tip of the county. Flexures of pronounced figure finger westward and northwestward away from the axis of the Cincinnati Arch. Some of these, such as the Meshack Dome, are undoubtedly of economic value, as indicated by some indexing oil and gas wells. The county is unfaulted so far as is known.

The most important mineral resource of Monroe County is petroleum and natural gas. These products are secured in commercial quantities on the waters of Cumberland River on Kettle Creek and in the vicinity of lower Meshack Creek. Oil is produced from six separate "sands" in the Ordovician series, including what is regarded as correlatives of the Upper and

Lower Sunnybrook and deeper Trenton "sands." The petroleum is high grade and during 1925 Monroe County produced 35,420 barrels valued at \$53,965.00.

Limestone, well distributed throughout the county, is one of the important resources of this district, the deposits being suitable for highway, railroad bed and building construction. Residual clays of excellent quality for ordinary brick making are available in uplands surrounding Tompkinsville, while in the bottoms of the Cumberland River alluvial clays might be secured for similar purposes. Brines were formerly produced for saltmaking purposes, but this industry, during the last century, has become decadent. Devonian shales outcropping within the eastern border of Monroe County are available in very large quantities for the production of artificial petroleum should this resource ever become of commercial value.

An oil and gas geographic map of Monroe County was prepared and issued in 1923 to the scale of 1 inch to the mile. The geologic structure of the eastern portion of Monroe County has been executed and was presented in 1924 on a map together with parts of Cumberland and Clinton counties at the same scale with 10 foot contour intervals based on the top of the Chattanooga (Devonian) black shale. This map presents a detailed surface and sub-surface stratigraphic section showing the position of important oil and gas "sands." Topography for the southern part of this district has been executed at the scale of 1:62,500, on the Tompkinsville and Lillydale sheets. The areal geology of that part of Monroe County embraced by these sheets is now in course of field survey and will probably be completed during 1929.

LXXXVII.

MONTGOMERY COUNTY.

Montgomery County is situated partly in the Outer Bluegrass and partly in the Knobs Belt of central eastern Kentucky. Areally it covers about 198 square miles. The county is drained by waters of Hinkston Creek and Slate Creek, both being northward flowing tributaries of the Licking River. A very minor



CLIFTED SANDSTONE ON PILOT KNOB.

This prominent outlier of the Coal Measures is capped by several heavy beds of the Pottsville conglomerate. The view to the north and northwest from this point over the Ordovician plain is superb.

amount of drainage falls to the southwest through Lulbegrud Creek into the Kentucky River. The topography ranges from rolling limestones in the northwestern part of the county to hilly and somewhat precipitous on the southeast. Mt. Sterling, the county seat, has an elevation of 950 feet, above which ridges and knobs near the Menifee line rise about 400 feet.

The hard rocks of Montgomery County consist of an alternating sequence of limestones and shales. These begin with the uppermost ledges of the Cincinnati (Ordovician) and rise up through the Silurian, Devonian and Mississippian into the basal conglomeratic sandstones of the Pennsylvanian. The latter are well exhibited as the capping formation on Pilot Knob, an isolated outlier of the Eastern Kentucky Coal Field. The struc-

ture of Montgomery County is monoclinal, the normal dip to the southeast being at about 25 to 35 feet to the mile. This tilted platform is faulted by the eastward extension of the Kentucky River Fault which passes slightly north of Levee through the headwaters of Lulbegrud Creek to the main waters of Slate Creek.

The most important mineral resource in this district is limestone, which is available in large quantities for all general purposes of highway, railroad bed and general building construction. Certain Ordovician limestones in the northern part of the



PATH THROUGH WOODS ON PILOT KNOB.

With many scenic as well as geological attractions this great hill in southern Montgomery is a popular rendezvous.

county and other beds in the Chester division of the Mississippian in the southeastern part of the county are suitable when crushed for use as agricultural lime. Residual "sands" and gravels from Coal Measure conglomerates are available in the southeastern part of the county for building and highway utilization. A small amount of oil and gas has been secured in a number of indexing wells from the shallow Corniferous "sand" at points not far removed from Menifee County, but commercial production in large amount has never been obtained. The broad outcrop of the Chattanooga-Olio (Devonian) black oil shale affords a large resource for the manufacture of artificial petroleum. Some steps to this end have already been taken in at least one experimental plant located somewhat southeast of Mount Sterling.

Montgomery county was mapped in 1928 to show areal geology, oil, gas, and other mineral development at the scale of 1 inch equals 1 mile. The geology, somewhat generalized, is also shown on an old reconnaissance map with Clark County in colors, at the scale of 1 inch equals 2 miles. The topography of the southern part of the district has been executed and is shown on the Beattyville quadrangle, scale 1:125,000.

LXXXVIII.

MORGAN COUNTY.

Morgan County occupies a central position geographically in Eastern Kentucky, the region being typical of the maturely dissected Cumberland Plateau. It covers an area of 413 square miles. West Liberty, the county seat, situated on the flood plain of the Licking River, the main artery of drainage in this district,



TOPOGRAPHY NEAR WEST LIBERTY.
Scale: 1 inch equals 2 miles. Contour interval 100 feet.

has an elevation of 850 feet. Ridge lands surrounding and to the southeast locally referred to as the "Mountains" rise to elevations ranging from 1,200 to 1,300 feet above sea level.

The hard rocks of Morgan County consist of limestones, sandstones, shales and coals principally of the Pottsville (Pennsylvanian) group. In the northwestern part of Morgan County, however, along the lower drainage of the Licking River, Upper and Middle Mississippian formations including the prominent Chester limestones come to outcrop. Fluvial quartzite pebbles and boulders of Cretaceous age are occasionally found in this district. River flood plain alluvium of Recent and possibly Pleistocene age are easily recognized along the Licking. Struc-

turally, Morgan County is a monocline tilted to the southeast. It is traversed by the Irvine-Paint Creek normal fault throughout its southern extremity. This fault striking generally north 65 degrees east may be readily seen on the waters of Stacey Fork of Caney Creek, and on Rockhouse Creek of Licking River. Its displacement ranges from 70 feet to 160 feet. On the south



AMONG MORGAN COUNTY HILLS.

The sediments exposed here on a branch of Licking River are all sandstones, shales and coals of Pennsylvanian age. The topography is typical of this part of Eastern Kentucky.

it is paralleled by the important Caney Anticline. The northern part of the district is very much flexed, the Jephtha Dome on the headwaters of Elk Fork being the most significant of the positive structures.

The principal mineral resources of Morgan County are cannel and bituminous coal, the district being noted particularly for its cannels which are widely exported. In the year 1925 there were produced and exported from Morgan County 28,509 tons of coal. Considerable amounts of petroleum have been secured in Morgan County from the "Corniferous Sand," the

Cannel City and Caney pools in the southern part of the district being the best known and most prolific. Considerable natural gas has been produced in the vicinity of Mize on Grassy Creek, and also on the waters of Elk Fork two miles below Lenox. In the latter field it has been recovered from the "Clinton Sand" in quantities sufficiently large to supply domestic consumers at West Liberty. Clays and clay shales suitable for brick and tile making are available as alluvial deposits in Licking River, and as residual beds in the Coal Measures.

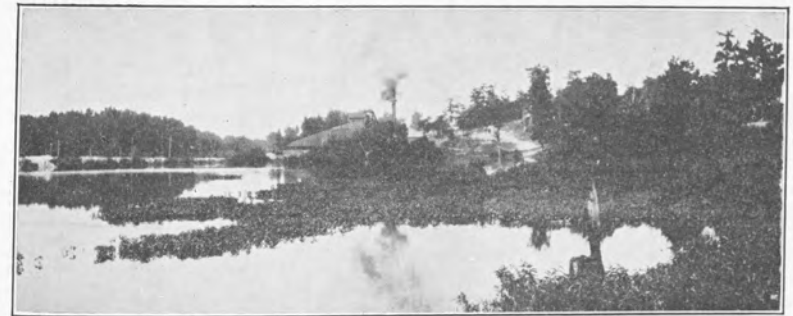
On the lower waters of Black Water Creek and in the valley of the North Fork of Licking River, limestones suitable for highway, railroad bed and rural building construction are available. These calcareous deposits might also be used for fluxing and for agricultural purposes. Cement materials in the form of limestones and clays suitable in quantity and quality are available for cement making purposes.

The district was mapped as a county unit to show its areal geology and its oil and gas structure in 1925, and a brief illustrated county report was published in Kentucky Geological Survey, Series VI, Vol. XXVI in 1921. Topography for all except the northern part of Morgan County is available on the Beattyville and Salyersville quadrangles at a scale of 1:125,000, and on the Paintsville Quadrangle at a scale of 1:62,500.

LXXXIX

MUHLENBERG COUNTY

Muhlenberg County is situated in the southern central portion of the Western Kentucky Coal Field. The district is drained by the main waters of Green River and its principal southern tributaries, Mud River on the east and Pond River on the west. These three streams form the county boundary for a consider-

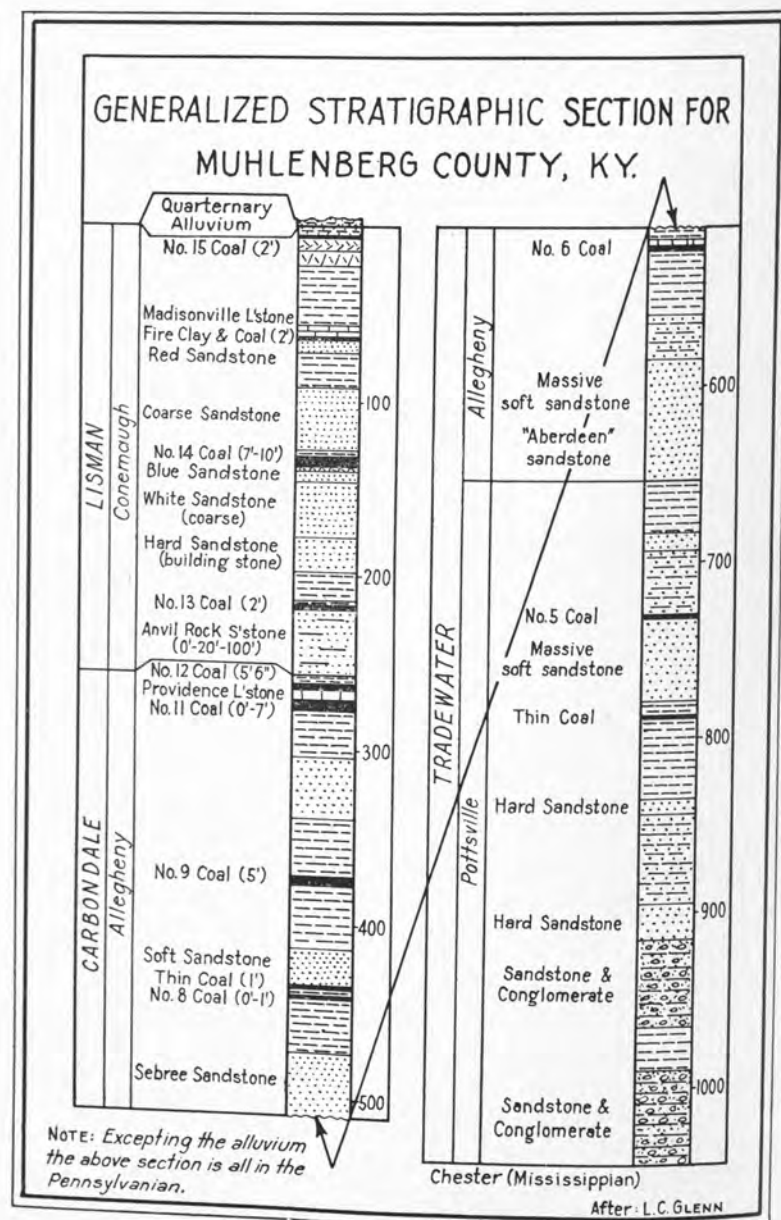


COAL OPERATION IN MUHLENBERG.

The coal producing areas in this county are broadly valley-filled and of low relief. Sharper physical features are found near the Todd and Logan boundaries.

able distance. Greenville, the county seat, with an elevation of 538 feet, is representative topographically of the middle uplands of the district though hill lands to the south rise to elevations ranging up to about 750 feet, while the lowest elevation in the county on the Green River just east of Stroud is 387 feet, giving a normal relief of 363 feet for this district. Broadly alluviated river flood plains at elevations ranging from 390 to 410 feet are a marked physical feature.

The hard rocks of this district are embraced chiefly within the Coal Measures, significant sequences of the Pottsville-Allegheny and Conemaugh (Pennsylvanian) being present. Representatives of the uppermost Chester are found, however, somewhat south of Wier on the headwaters of Long Creek and Pond River. Alluviums of Pleistocene and Recent age are present in the valley flats. The regional structure of Muhlenberg County



STRATIGRAPHIC SECTION FOR MUHLENBERG COUNTY.

is a monocline tilted at low angles to the northwest into the interior of the Western Kentucky Coal Field. The county's northern boundary is roughly parallel with the axis of the geo-syncline. The regional structure is deformed by a number of generally northeast southwest striking faults, some of which pass completely across the county and are coincident with major areal geological boundaries. A number of important flexures of plunging anticlinal type are present, particularly in the southern part of the county.

The chief mineral resource of Muhlenberg County is bituminous coal, which is produced principally in the northern part of the district. About eight identifiable coals are known to be present in this region, and of these the No. 9 and No. 11 are the most important. In the year 1925, 3,517,238 tons of coal were produced and exported from Muhlenberg County. Oil and gas in commercial quantities have been recovered in Muhlenberg County, principally in the vicinity of Twin Tunnels on the middle waters of Rocky Creek. Clays and clay shales of alluvial and residual origin are available in this district for brick and tile manufacture.

An oil and gas and coal map of Muhlenberg County showing the topography of the entire district, at the scale 1:62,500 with a contour interval of 20 feet was prepared in 1924. The geology of parts of this district has been described separately for several of the quadrangles but a unit county report has not been issued. The separate topographical quadrangles embracing Muhlenberg County are: Madisonville, Central City, Hartford, Nortonville, Drakesboro, and Dunmore, all scaled 1:62,500.

XC

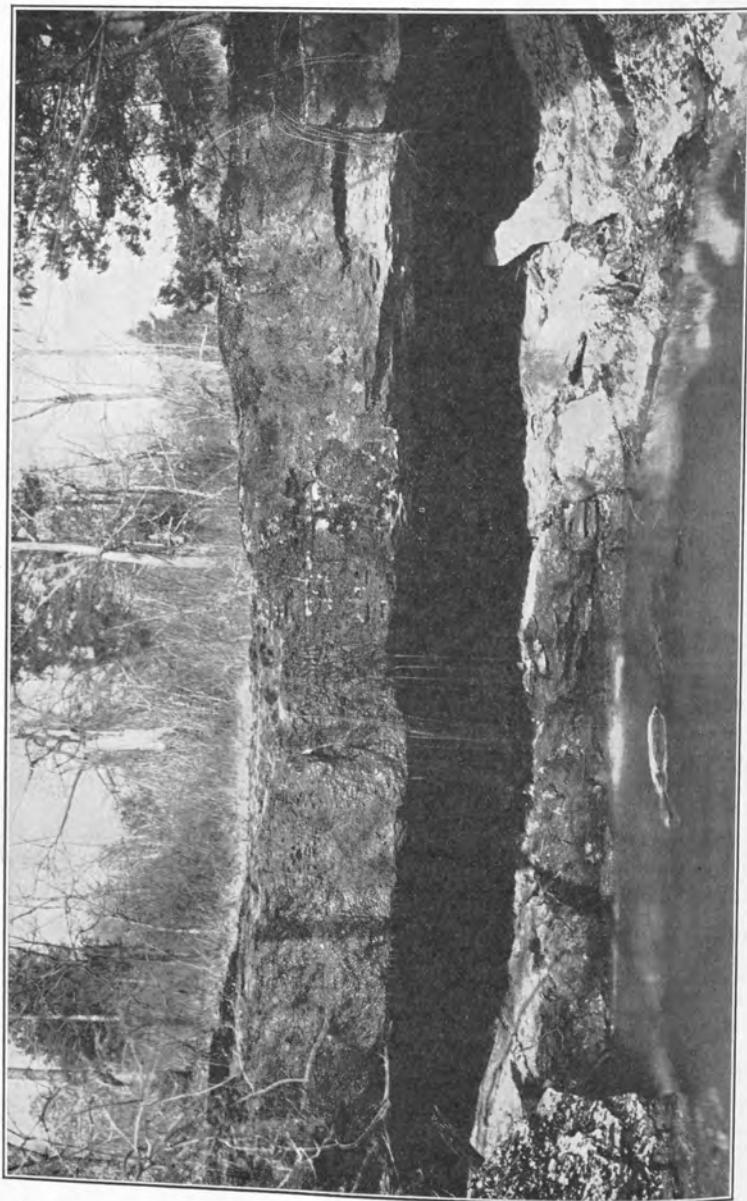
NELSON COUNTY.

Nelson County is situated in the central part of Kentucky, partly in the Outer Bluegrass Region, and partly in the Knobs Belt. It encompasses 417.5 square miles. The district is drained by Rolling and Beech Forks of Salt River and their tributaries, including Wilson Creek, which separates it from Bullitt County on the north. Bardstown the county seat, with an elevation of 625 feet, is representative of the Middle uplands of this county. It is exceeded by many ridges and isolated knobs to the south-east which rise to elevations of about 1,100 feet.

The hard rocks of Nelson County are encompassed within a long sequence of limestones, sandstones and shales, the sediments beginning with the Upper Ordovician and extending upwards stratigraphically through the Silurian, Devonian, Lower and Middle Mississippian divisions of the Paleozoic System. Alluviums of Pleistocene and Recent age are found in the lower stream bottoms. Structurally the county is monoclinal, dipping to the southwest at low angles and unfaulted so far as is now known, though the southern tip of this district passes close to a hypothetical line of fracture, thought possibly to unite the Kentucky River-Paint Creek-Irvine Fault of Eastern Kentucky with the Rough Creek disturbance of Western Kentucky.

The most important mineral resource of Nelson County is limestone, which occurs throughout the county in suitable quantity and quality for all purposes of roadway, railroad bed, and rural building construction. Certain Nelson County limestones might be used for cement making and others for agricultural lime. The district contains many calcareous beds described as agricultural marls. These are of marked importance from a standpoint of soil fertilization. Small deposits of asphaltic impregnated limestones (Corniferous) exist on the waters of Cedar Creek, but it is suspected not in quantities to make them of commercial importance for road building. Alluvial and residual clays are available for brick making.

The district was mapped in reconnaissance geologically in 1886. This map was presented in colors with Spencer County at



ASPHALTIC LIMESTONE IN NELSON COUNTY.
One of the few areas in Kentucky to exhibit an outcrop of the Corniferous (Devonian) limestone thoroughly saturated with petroleum residues is found in western Nelson County.

the scale of one inch equals two miles, but is now exhausted in edition. A new survey of Nelson County separately was executed in 1928 and this map, scaled 1 mile to the inch, has been published in colors and is now available.

XCI

NICHOLAS COUNTY.

Nicholas County, containing 202.69 square miles, is situated in the northeastern part of northern central Kentucky, the terrain being typical of the Outer Bluegrass Region. Carlisle, the county seat, has an elevation of 850 feet, but is exceeded by ridges to the southeast, rising to about 1,000 feet above sea level.



OLD BLUE LICKS SPRING.

After producing a very superior mineral water since Colonial days, this spring a few years ago failed completely. Efforts to revive it have been unsuccessful. This area has produced many Pleistocene mammal fossils. It is faulted with a displacement of about twenty feet.

Nicholas County is drained by the Licking River, which bounds it on the northeast. Hinkston Creek, a tributary of the South Fork of the Licking River, drains this district on the west. Topographically, the district is hilly throughout, the waters of main Licking River being rather deeply entrenched in a narrow meandering valley.

The hard rocks of Nicholas County consist of a sequence of Ordovician limestones, shales and thin sandstones, beginning with the upper members of the Champlainian group extending well up into the Cincinnati. The flood plain of the Licking

River exhibits considerable areas of alluvial deposits, all of Recent and Pleistocene age. The structure of Nicholas County is monoclinal, the tilt being to the east, as can be readily seen from its geographic position on the eastern flank of the Lexington Dome of the Cincinnati Arch. Minor flexures traverse the entire county, but faults of major significance are unknown.

The most important mineral resource of Nicholas County is limestone, which is available in quantity and quality necessary for use in highway, railroad bed, and rural building construction. The district presents some clays of both alluvial and residual character which might be used for ordinary brick making. Mineral waters of exceptionally fine therapeutic value were produced naturally and more recently artificially at the lower Blue Licks. Although within recent times these springs have failed, it is undoubtedly probable that Blue Lick mineral waters once so widely known and used may be again secured by drilling to the producing horizon in the underlying Ordovician beds.

Nicholas County was mapped geographically in 1925 at the scale of one inch to the mile together with Robertson County. Neither detailed geological nor topographical surveys have been executed for this district as a whole, but such investigations were completed in 1928 for a small area in the vicinity of Blue Licks battlefield in this county and the adjoining county of Robertson.

XCII.

OHIO COUNTY

Ohio County, containing 620.77 square miles, is situated in the central eastern portion of the Western Kentucky Coal Field. The district presents a rather unique combination of hill lands intercepted by broad alluviated bottoms in many of which un-



ROUGH RIVER AT HARTFORD.

Slack water from the Green extends up to about this point, making navigation for small craft possible. There are, however, many sharp and extended meanders to be encountered en route.

consolidated sediments attain a thickness of from 50 to 75 feet. Hartford, the county seat, has an elevation of 425 feet and is surrounded by hill lands rising to upwards of 650 and 700 feet. The minimum elevation, 401 feet, is in the vicinity of Livermore, where the Green River crosses the McLean County line. The average relief in the district ranges from 100 to 150 feet, while the maximum relief is about 300 feet.

The hard rocks of Ohio County consist of limestones, sandstones, shales and coals of the Carboniferous group. The oldest sediments are of Chester (Mississippian), and the youngest are of Conemaugh (Pennsylvanian) age. Unconsolidated sediments of fluvial and lacustrine origin ascribable to Recent and Pleistocene deposition fill the lower creek and river valleys. The structural aspect of Ohio County is that of a great faulted anti-

cline. The normal dip of the northern part of the county is to the northwest, while that of the southern part of the county is to the southwest towards the trough of the Western Kentucky Coal Field. The line of division is the Rough Creek disturbance,



PRODUCING OIL WELL, SUNNYDALE POOL.

The wells in this field are shallow but produce a good grade of oil from a real silica sand—the "Jett."



DRILLING OPERATIONS SUNNYDALE OIL FIELD.

a rather broad belt of faulting and folding which takes a generally east and west strike from the Grayson County line in the vicinity of Olaton and Dundee slightly north of west to the McLean County line near the Daviess, McLean and Ohio County corner. Displacement along this fault is various, the maximum difference of stratigraphic position being as much as 1500 feet

or more. Farther west in the heart of the coal field this displacement, distinctly overthrust, measures to as much as 3000 feet.

The principal mineral resources of Ohio County are bituminous coal and petroleum. The chief coal seams are the No. 9 and No. 11 producing principally in the southwestern part of this district. Other coals, however, including No. 4 and No. 7, and one or two strays are also operated. The coal production of Ohio County in 1925 was 618,565 tons. The northern part of Ohio County more or less barren of commercial coal seams, is



PENNSYLVANIAN SANDSTONE NEAR BUFORD.

This outcrop on the Pleasant Ridge-Hartford road is characteristic of many Coal Measure exposures in Ohio County. Mississippian limestones are found exposed within the zone of the Rough Creek disturbance.

now being rapidly developed for petroleum, the daily production exceeding at the present time 6500 barrels. Some natural gas has been produced at various points in this district, and the prospects for a continued increasing development of both petroleum and natural gas is apparently excellent.

OHIO COUNTY OIL PRODUCTION

Year	Volume	Value
1922.....	1,265.61 bbls.	\$2,169.96
1923.....	9,789.21 bbls.	14,177.04
1924.....	78,631.32 bbls.	122,175.06
1925.....	165,039.38 bbls.	294,871.85
1926.....	362,908.72 bbls.	740,538.84
1927.....	1,325,731.06 bbls.	1,808,322.42
1928.....	2,020,145.83 bbls.	2,915,727.27

Clays and clay shales of transported and residual character are widely distributed throughout this district in quantity and quality suitable for ordinary brick making. Limestones suitable for roadway and railroad bed construction are present at many points along the line of the Rough Creek disturbance where local uplift has brought them to the surface.

Ohio County was mapped geologically at the scale of one inch equals one mile in 1927, but this sheet showing oil, gas, and coal development, became in such demand that the edition was exhausted in the summer of 1928. A new edition of this map completely revised as to oil development and published in colors was issued late in 1928. A sub-surface structural map of the Ambrose Oil Pool was issued in 1927. The entire district has been surveyed topographically at the scale of 1:62,500, and is presented on the Sutherland, Whitesville, Central City, Hartford, Spring Lick, and Narrows Special (without contours) sheets, the contour interval being 20 feet.

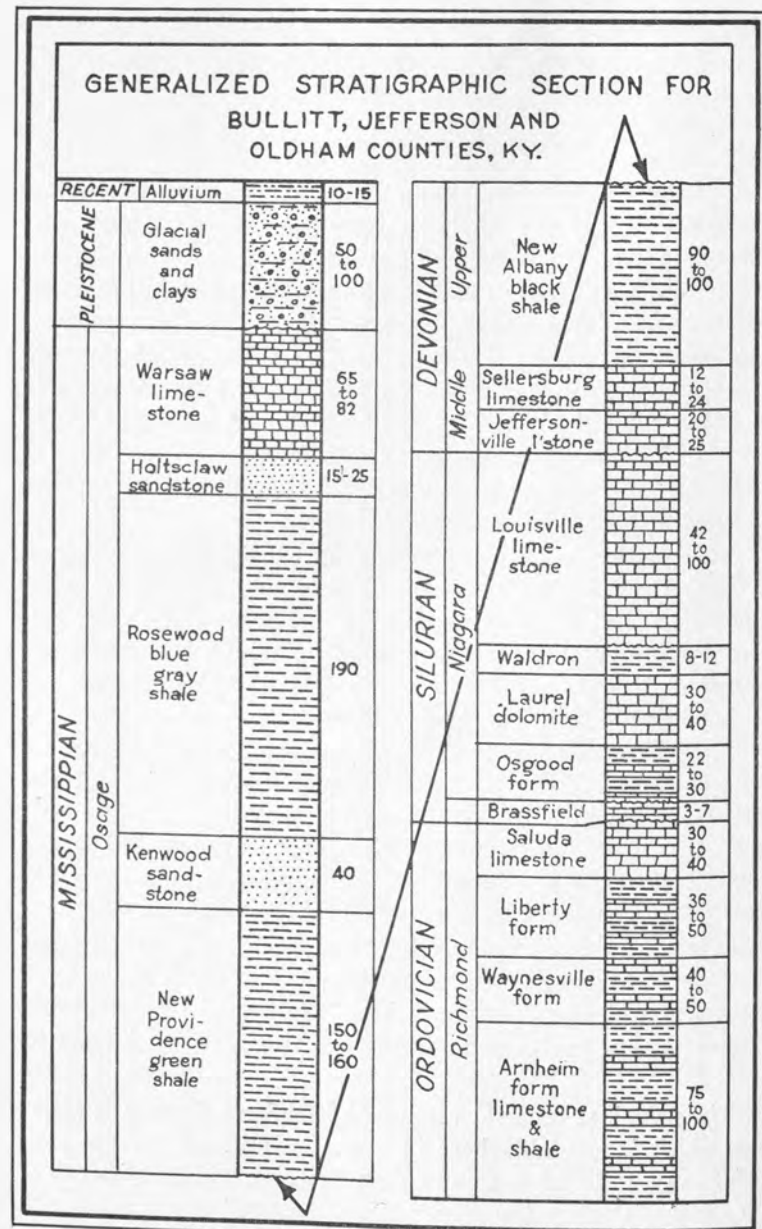
XCIII.

OLDHAM COUNTY

Oldham County, containing 191 square miles, is situated principally in the northwestern extension of the Knobs Belt adjacent to the Ohio River and State of Indiana. The easternmost part of this county exhibits, however, the physical features characteristic of the Outer Bluegrass Region. The district is quite maturely dissected throughout. LaGrange, the county seat, has an elevation of 850 feet, and this is representative of the hill or ridge lands of the entire county. A minimum elevation of 440 feet is found on the flood plain of the Ohio River at the Jefferson County line. The district throughout is hilly, but the average relief is not more than 150 feet.

The hard rocks of Oldham County consist of the sequence of Upper Ordovician, Silurian, and Devonian limestones, sandstones and shales, the lowermost sediments being principally calcareous representatives of the Upper Cincinnati, while the youngest sediments are Jeffersonville (Devonian) limestones occurring in very thin restricted outliers. Bottoms of the Ohio River and Harrods Creek show alluvial and glacial sediments of Recent and Pleistocene age. The northwestern part of the district was covered by the Illinoian glacial ice sheet and outwash. Occasional Canadian erratics chiefly of the typical jasper conglomerate type are found not far removed from the Ohio River. The structural attitude of Oldham County is that of a northwestward dipping monocline as may be readily seen from its low position geographically on the western flank of the Lexington Dome of the Cincinnati Arch. Minor flexures traverse this county, but faults of major significance are not known to occur.

The principal mineral resource of Oldham County is limestone which is available here in quantity and quality suitable for highway, railroad bed and urban building construction. Certain Oldham County limestones might be used for cement and agricultural lime purposes. Clays and clay shales of both transported and residual character are available for ordinary brick



STRATIGRAPHIC SECTION IN OLDHAM, JEFFERSON AND BULLITT COUNTIES.

making. Wells of medium depth drilled into the underlying Ordovician sediments will produce mineral water of excellent character. A number of springs of rather surficial origin occur in the vicinity of the Silurian and Devonian limestones. Good sands and gravels in inexhaustible quantity may be taken from the bed of the Ohio River. Oil and gas in very small quantities have been found in wells drilled to shallow depths into the Ordovician beds chiefly in the vicinity of LaGrange.

Oldham County was mapped geographically in 1925 at the scale of one inch equals one mile. The topography of all this district except the northern tip is shown on the Prospect and LaGrange sheets, scale 1:62,500 presented with a contour interval of 20 feet.

XCIV.

OWEN COUNTY

Owen County is situated in the northern central portion of the Bluegrass Region. It contains 367 square miles. Although well within the interior of this district its surface formation including the Eden shale and its medial position on the northwest-



TILTED MAYSVILLE BEDS IN OWEN.

Considerable sharp and highly localized folding has taken place in the Ordovician limestones and shales of this part of Kentucky.

ern flank of the Lexington Dome of the Cincinnati Arch indicates its inclusion within the Outer Bluegrass Belt. Owenton, the county seat, with an elevation of 1000 feet, is representative of the uplands of this district. Physiographically the region is maturely dissected, the drainage falling to the west and southwest through minor tributaries into the Kentucky River, and northeastwardly into Eagle Creek. The normal relief of this rather hilly district ranges from about 200 to 250 feet, a minimum elevation of about 450 feet being found on the Kentucky River flood plain at the Carroll County line near Worthville.

The hard rocks of Owen County consist principally of limestones, shales and thin sandstones of the Cincinnati (Upper Ordovician) although representatives of the underlying Champlainian group (Middle Ordovician) are to be observed in the valley of the Kentucky River as far to the north as the mouth

of Drennon Creek on the western side of this district, and again in very restricted areas of the bottoms of the upper waters of Eagle Creek near the Scott County line. Recent and Pleisto-



OWEN COUNTY UPLANDS NEAR WHEATLEY.



ORDOVICIAN LIMESTONES ON KENTUCKY RIVER.
These beds clefted around the outside of strong meanders give Owen County much delightful river scenery.

cene alluvial and glacial sediments make up the flood plain of the Kentucky River and lower Eagle Creek adjacent to the Carroll County and Gallatin County lines. While it is not certain that this district was ever covered by the ice sheet, certain evidences of glacial outwash and ponding are present throughout

the northern part of the county and occasional erratics of Canadian origin have been found.

The structural attitude of Owen County is monoclinal, the normal dip being to the northwest. Minor flexures of frequently high angle traverse this county as can readily be seen in the gorge of the Kentucky River. The district is unfaulted except for one or two fractures of small displacement easily observable close to low waters in the Kentucky River channel chiefly between Monterey and Gratz.

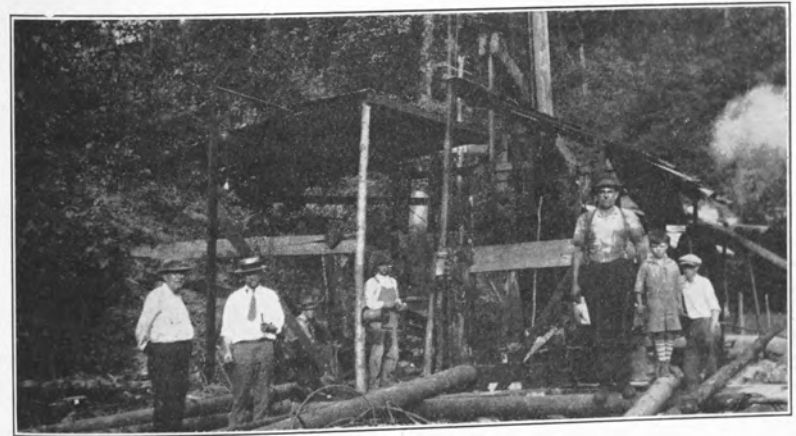
The principal mineral resource of Owen County is limestone which is produced in quantity and quality adequate for highway and railroad bed construction. Some grades of Owen County limestones are used for rural building purposes. The Kentucky River affords an unlimited supply of good grades of sand, and the district exhibits a number of springs, some of shallow and others of deeper origin containing minerals of recognized value. In the vicinity of Gratz and Lockport, fissures possibly somewhat faulted, exhibit mineralized vein deposits of barite, galenite, sphalerite and calcite. The latter is not a rare mineral in the county but is usually found in small quantities.

Owen County was mapped geographically in 1923 at a scale of one inch to the mile. The topography for the southwestern portion of this district has been executed on the Lockport Quadrangle at a scale of 1:62,500 with a 20 foot contour interval.

XCV.

OWSLEY COUNTY

Owsley County covering an area of 201.66 square miles, is situated in the central western portion of the Eastern Kentucky Coal Field. Although physiographically the region is nothing more than maturely dissected hill lands such as are characteris-



DRILLING ON ISLAND CREEK IN OWSLEY.

Oil in large quantities was discovered here in what drillers referred to as the "Big Injun" sand, a porous limestone of the Middle Mississippian. Several wells were drilled but the pool produced only a short time.

tic of the western margin of the Cumberland Plateau it is frequently referred to as a part of the "Mountains." Booneville, the county seat, located close to the flood plain of the South Fork of the Kentucky River, the major line of drainage, exhibits an elevation of 675 feet. Hill lands to the southeast attain elevations of 1350 feet and 1400 feet, giving a usual relief of about 350 to 500 feet.

The hard rocks of Owsley County consist of Pottsville (Pennsylvanian) sandstones, sandstone conglomerates, shales and coals, the surface rocks above exhibiting about 600 or 700 feet. Flood plains along the lower waters of the South Fork of the Kentucky River exhibit alluvial deposits of Recent and possibly Pleistocene age.

The structural attitude of Owsley County is monoclinal, the dip being to the southeast at the rate of about 30 or 35 feet to the mile. Traversed by a number of flexures this regional dip is frequently modified. Such an instance may be cited in the case of the Rockcastle River Uplift, a major fold striking north-eastwardly across the southern central portion of the county. Along this structure strong reversals to the normal inclination of the beds may be seen. No faults of major significance are known in this district.

The principal mineral resources of Owsley County are bituminous coal, petroleum and natural gas, the latter two being produced chiefly from the Corniferous (Devonian) and Big Injun (Mississippian) "sands." Although there are about six coals present in Owsley County, some of which are of commercial value, an absolute lack of railway transportation has resulted in withholding this mineral from export. Petroleum is produced in Owsley County in commercial quantities in the Mistletoe, Island Creek, and Elk Lick pools, the producing sands being found in the Corniferous (Devonian) and the Big Lime (Mississippian). The most significant gas producing area is in the vicinity of Turkey Knob on the waters of Sturgeon Creek in the northwestern part of Owsley County. This district is now the principal producing field of the public utilities natural gas used in Lexington, and adjacent central Kentucky towns. Clays and clay shales of residual and transported character in suitable quality and quantity for ordinary brick making are found in Owsley County.

The county was mapped structurally for oil and gas in 1925 at the scale of one inch to the mile, with a ten foot structural contour interval, the key bed being the Fire Clay coal which it should be noted is only present in the southeastern part of this district. The topography of Owsley County is shown on the Beattyville and Manchester reconnaissance quadrangles at the scale 1:125,000, with a 50 foot contour interval.

XCVI.

PENDLETON COUNTY

Pendleton County is situated in the northern part of the Outer Bluegrass Region of Kentucky, the northeastern tip of this district touching the Ohio River and the State of Ohio. It embraces 279 square miles approximately. Falmouth, the county seat, with an elevation of 525 feet is located at the juncture of



ALONG THE COVINGTON-FALMOUTH ROAD.

Pendleton County sharply etched topographically presents an ever changing and charming panorama. Maysville shaley limestones are exposed at the left.

the North and South Forks of the Licking, this river being the major line of drainage in this area. Hill lands steep of slope with a normal local relief ranging from 150 to 200 feet are found throughout the entire district. Flat lands are restricted to small areas along the flood plain of the Licking River. The structural attitude of Pendleton County is a monocline dipping to the northeast from a medial position on the northeastern flank of the Lexington Dome of the Cincinnati Arch.

The hard rocks of Pendleton County consist of a sequence of Ordovician limestones, shaly limestones and shales with occasional thin sandstones, the principal formation at outcrop being the Eden shale in the hill lands. Fluvial sands, gravels and clays of Pleistocene and Recent age are found compos-

ing the flood plains of the Licking River, and lower waters of Greasy Creek, and other adjacent tributaries.

The principal mineral resource of Pendleton County is limestone which is found in inexhaustible quantity suitable for highway, railroad bed and rural building construction. Clays suitable for common grades of brick are available in this district. Mineral waters from the well known Blue Licks horizon may be secured from drilled wells of medium depth.

Pendleton County was mapped in 1928 to the scale of one inch to the mile. No detailed geology or topography has been executed for this district except along a narrow strip bordering the Ohio River which is shown on the new Felicity Quadrangle at the field scale of 1:48,000.

XCVII.

PERRY COUNTY

Perry County is situated in the heart of the Eastern Kentucky Coal Field. In area it covers 335 square miles. Hazard, the county seat, with an elevation of 873 feet, is located on the flood plain of the North Fork of the Kentucky River, the major line of drainage of this district. The topography is characterized by extensive hill and ridge lands commonly described as



TOPOGRAPHY NEAR HAZARD.

In this part of Perry County the North Fork of the Kentucky River has entrenched itself in a meander which bounds the city.

“mountains” exhibiting a normal relief of from 500 to 1000 feet. Uplands in the southeastern portion of this district rise to 2200 and 2300 feet. Very occasional peaks on the Harlan County line attain to 2500 feet.

The hard rocks of Perry County consist of a long sequence of Pennsylvanian elastic sediments, sandstones, sandy shales and coals. These rocks are principally of Pottsville age, though thin restricted layers of the Allegheny are found capping the ridge tops to a considerable extent east of the North Fork and elsewhere. Level areas are restricted to the flood plains of the Kentucky River and its major local tributaries. The fluvial deposits are Recent in age and consist of sands, gravels, and clays. The structural attitude of Perry County is geo-synclinal, the district being bisected by the Eastern Kentucky Geo-syncline which plunges sharply to the northeast from the vicinity of

Krypton across the waters of Troublesome Creek. As a unit this district is flexed locally into a number of anticlines and synclines with an occasional dome as evidenced by the structural configuration of the Fire Clay coal. No faults of major significance are known.



WALNUT SPLITTING SANDSTONE BOULDER.

Nature builds and destroys. A sandstone block produced after millions of years is in process of reduction here on the head of Gay's creek in Perry County. Active agents are vegetation and winter frosts.

The principal mineral resource of Perry County is bituminous coal, the district having produced for export during 1926 a total of 6,647,807 tons. In a sequence of about 12 surface seams, the following are the most important commercially: No. 4, No. 5, No. 6, No. 7, No. 8, and No. 9. The Fire Clay coal (No. 4) is seen in its type locality in this region. Proximity to the Pine Mountain Overthrust on the southeast has insured a regional metamorphism of the coals which has greatly improved their quality for both industrial and domestic purposes. Oil in small quantities and gas in what is believed to be commercially important quantities are contained in the Pennsylvanian sediments underlying Perry County. Deeper drilling might reveal these hydrocarbons in older formations, particularly the immediately underlying Mississippian and Devonian.

The structural geology of Perry County was executed in 1924 on the Fire Clay coal as a key, at a contoured interval of

10 feet, with a horizontal scale of one inch equals one mile. The topography of this district has been completed and is presented on the Buckhorn, Troublesome, Hyden, and Cornettsville quadrangles at a scale of 1:62,500, and on the Manchester Quadrangle, scale 1:125,000.



OPENING IN THE HAZARD OR NO. 6 COAL.

Perry County is far famed for its excellent coal and among these the Hazard seam stands first for both domestic and industrial uses.

XCVIII.

PIKE COUNTY

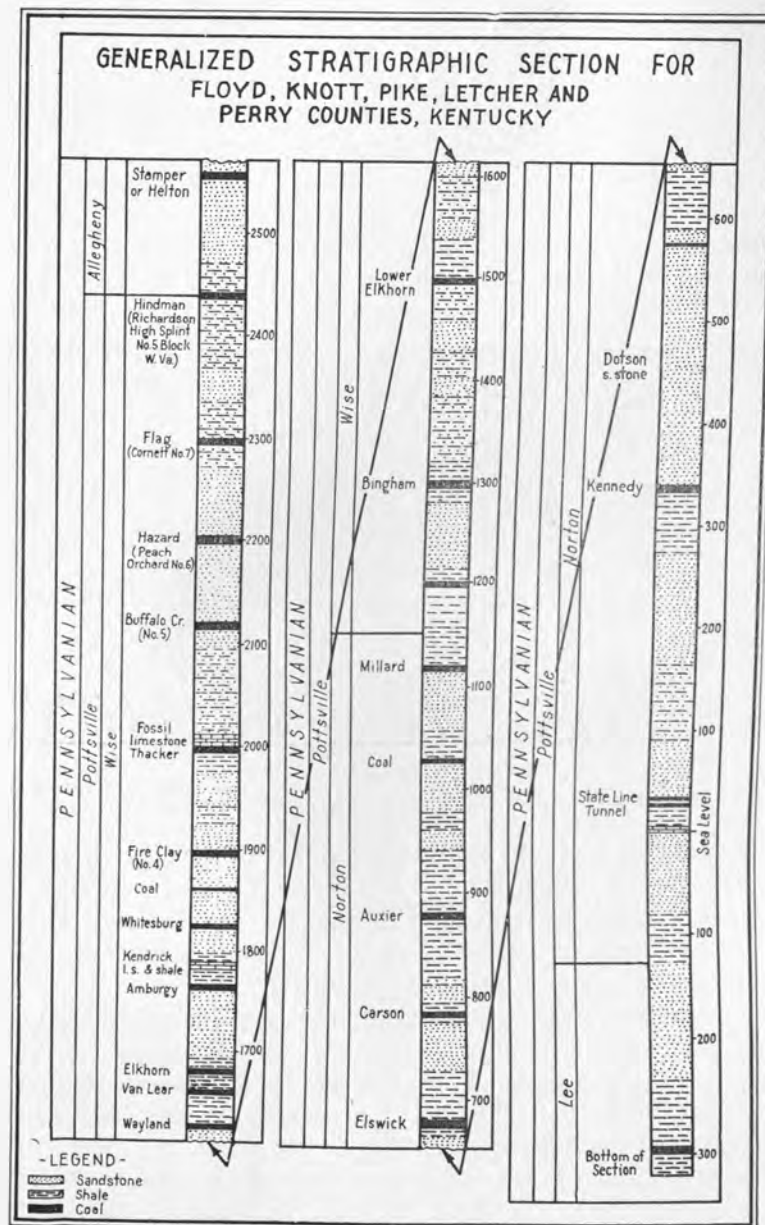
Pike County is situated in southeastern Kentucky adjacent to the States of Virginia and West Virginia. Areally it is the largest county in Kentucky, covering 779 square miles. It is drained by the Tug and Levisa Forks of the Big Sandy. Pikeville, the county seat, with an elevation of 685 feet. is located on



IN THE "BREAKS OF SANDY."
This point on the Russell Fork of Big Sandy is one of the most rugged in Eastern Kentucky. It is just north of the Virginia State line.

the Levisa Fork in the central western part of the district, which throughout is extremely hilly. The region is in fact quite typical of the maturely dissected Cumberland Plateau. It lies adjacent to and includes a portion of the Pine Mountain range, one of the two mountains of real elevation in Kentucky.

The hard rocks of Pike County consist principally of Pennsylvanian elastic sediments—sandstones, sandstone conglomerates, shales, and coals. These beds are for the most part correlated with the Pottsville, but thin representatives of the Allegheny cap the hilltops as outliers in the northern part of the county adjacent to the Martin line. A small area on the northwest flank of the Pine Mountain exhibits limestones of Middle and Upper Mississippian age. The flood plains of the Tug and Levisa Forks and their tributaries are composed of fluvatile



STRATIGRAPHIC SECTION IN PIKE AND ADJACENT COUNTIES.

sediments, sands, clays and gravels of Recent deposition. The structural attitude of Pike County located just within the southeastern tip of the Eastern Kentucky Coal Basin is that of a monocline dipping sharply, as mapped on the VanLear coal, to the north and northeast. This normal dip, however, is frequently flexed by local anticlines, domes and synclines, the most pronounced of which is the D'Inwilliers Anticline striking pronouncedly to the northeast into Mingo County, West Virginia. The subsurface structural geology of Pike County is prominently contrasted with that seen at the surface as evidenced by deep drilling which indicates a continuation of the normal southeastern dip away from the Cincinnati Arch into the Appalachian Basin.

The principal mineral resource of Pike County is bituminous coal. During 1926 a total of 7,820,301 tons of coal were produced for export in this district. In a sequence of 20 or more seams, about five, the Wayland, the VanLear, the Elkhorn, the Fire Clay and Pond Creek coals are of large commercial significance at the present time. Some cannel coal is operated in this district in connection with the mining of bituminous coal. Oil in very small quantities and gas in somewhat larger amounts have been secured in Pennsylvanian "sands" in this district, but commercial development of importance has not yet been obtained. Sandstones suitable for rural building construction and for base course work in highway building are available at many points in this county. Fluvial and residual sands are used for building construction. Clays and clay shales suitable for the manufacture of common brick may be obtained at various points.

Pike County was mapped structurally in 1923 on the Van Lear or Upper Marrowbone coal with a contour interval of 10 feet. The district has been mapped topographically on the Mattewan, Harold, Hurley, Pikeville, Pond, Regina, Williamson, and Clintwood sheets; scale 1:62,500.

XCIX.

POWELL COUNTY

Powell County is situated in central eastern Kentucky on the western border of the Eastern Kentucky Coal Field. A relatively small unit it covers only 181.83 square miles. The western part of the county is included within the Knobs Belt, while the



PROSPECT IN KENTUCKY OIL SHALE.

When freshly faced the Chattanooga shale exhibits a conchoidal fracture as may be seen in this opening near Clay City in Powell County.

eastern part of the county tips into the edge of the Cumberland Plateau. Stanton, the county seat, with an elevation of 662 feet, is located on the flood plain of the Red River, the major line of drainage. Knobs on the north and ridge lands to the east and south rise to elevations of 1200 and 1300 feet. The normal relief of the district is about 450 feet, while the maximum relief is about 750 feet, the lowest elevation about 600 feet being at the juncture of Lulbegrud Creek and Red River.

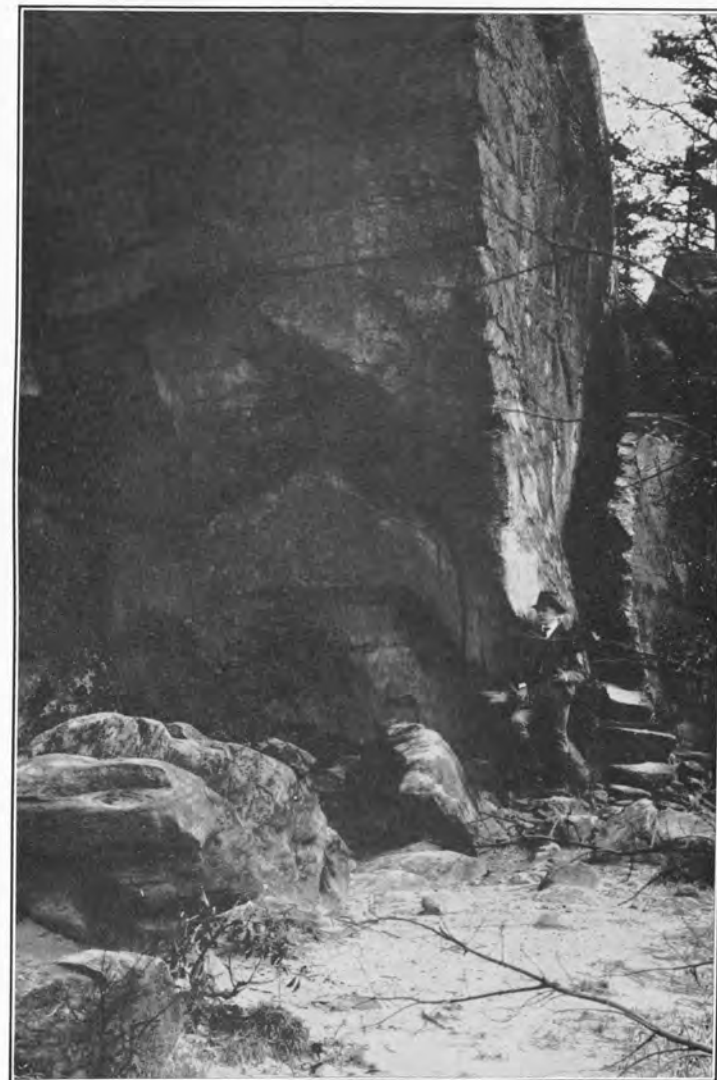
The hard rocks of Powell County consist of a sequence of Paleozoic sediments beginning with the highest representatives of the Ordovician and extending upward through the entire Silurian, Devonian and Mississippian divisions, and well into the

basal Pottsville (Pennsylvanian). These sediments consist of limestones, sandstones, sandstone conglomerates, shales and coals. In the bottom of Red River and some of its larger tributaries alluviated sediments of fluviatile origin are broadly displayed. These consist of sands, gravels, clays and silts of Pleistocene and Recent age.

The structural attitude of Powell County is that of a monocline dipping normally to the southeast away from the axis of the Cincinnati Arch. The entire county, however, is flexed locally, fingering anticlines and synclines plunging to the south and southeast. The southern part of the district is pronouncedly marked by a triplicate line of generally east and west faulting of major significance. This disturbance is known as the Irvine-Paint Creek Fault, displacement along its course varying from 125 to 180 feet, the upthrow being generally on the southern side.

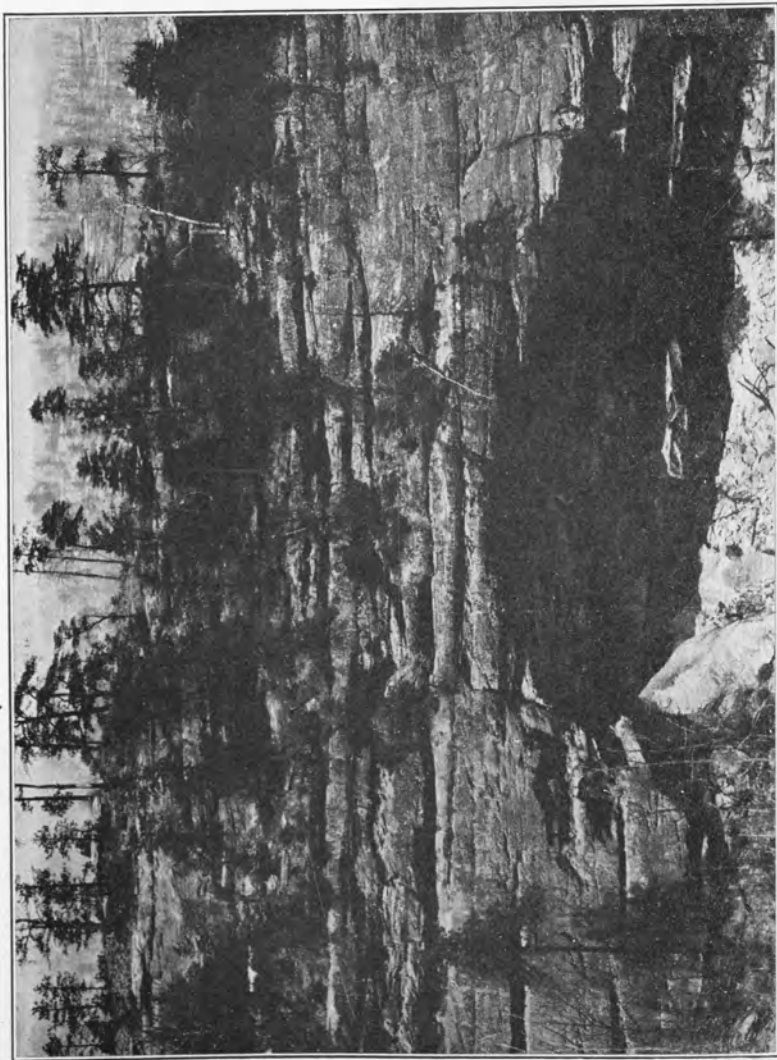
The mineral resources of Powell County are various. Chief among them is petroleum which is produced from the Pilot and Elk Fork pools on the head of the Red River closely adjacent to the Estill and Lee County lines. During 1922 the production of Powell County was 206,420 barrels valued at \$419,362.00. Natural gas has been produced in Powell County, particularly adjacent to the Menifee County line, where there has been developed on the headwaters of Cane Creek a southern extension of the well known Frenchburg and Rothwell Pool.

Limestones suitable for highway, railroad bed and general rural building construction are available in Powell County though utilized to a very slight extent. Certain of these limestones are also of fitting grade for use as cement materials, and others would be desirable for utilization as agricultural lime. Individual limestone beds high in calcareous content occur in this district which might be used in metaliferous industries for fluxing purposes. Powell County presents a group of alluvial and residual clays which are suitable for brick and tile manufacture, and also for inclusion in Portland cement materials. One or two thin coal seams are known in the eastern part of this county and are used to some extent for domestic purposes. In the western part of the county the Chattanooga (Devonian) oil shale comes to outcrop in considerable thickness over a very



TRAIL UNDER NATURAL BRIDGE.

Although Kentucky has a number of rock bridges of natural origin this one in Powell County surrounded by a new State Park is the most widely known.



ROCKHOUSE BENEATH POTTSVILLE SANDSTONE CLIFFS.
Throughout the western border of the Eastern Coal Field in Kentucky "spalled off" blocks give rise to many pseudo-caves such as this one in Powell County. Formerly used as shelters by hunters and trappers, they still possess some value of this order for live stock.

broad territory. It has been prospected for the purpose of manufacturing artificial petroleum and associated by-products. Eventually these deposits will afford a large source for such an industry. One of the principal resources of Powell County is its scenery, the district being well and widely known for its rugged uplands in the east and its broad beautiful valleys in the west. In the upper Red River valley there occurs a number of natural sandstone bridges, the largest and most accessible of which is to be found in Natural Bridge State Park. This arch developed in the Pottsville conglomeratic sandstone on the ridge top is the largest and most impressive structure of its kind in Kentucky.

Powell County was mapped geographically to show oil and gas development in 1927 to a scale of one inch equals one mile. The topography of this county is presented on the Beattyville and Richmond quadrangles at the scale of 1:125,000, contour interval 100 feet.

C.

PULASKI COUNTY

Pulaski County is situated in central southern Kentucky, the western portion of the county being included within the Pennyroyal district, while the eastern part tips across the western margin of the Cumberland Plateau. The area of the county is 628 miles square. Somerset, the county seat, with an elevation of 879 feet, is located on a rolling limestone upland between



RESERVOIR KNOB QUARRY.

Pulaski County has many excellent rock operations chiefly making use of Mississippian limestones which are broadly distributed.

the waters of Pittman and Fishing creeks, south flowing tributaries of the Cumberland River, the major line of drainage. The eastern part of the county is bounded by the Rockcastle River. The western margin of the Eastern Kentucky Coal Field somewhat further to the west is marked by Buck Creek. Both of these streams are of considerable size and flow south into the Cumberland River system. Karst topography marked by many sink holes, caves, and sinking streams characterize the eastern central part of the district. Maximum elevations of 1325 feet

are found on the drainage of the Rockcastle River near Mt. Sterling; while a minimum elevation of 600 feet occurs just above the mouth of White Oak Creek at the Wayne County line in the lowlands of the Cumberland River. The usual relief throughout the county ranges from about 150 to 300 feet, while the maximum relief for this district is 725 feet.

The hard rocks of Pulaski County consist of a long sequence of Paleozoic sediments, the lowermost of which are limestones high in the Ordovician series a few miles immediately west of Somerset in Fishing Creek valley. Ascending stratigraphically the entire local sequence of the Silurian, Devonian and Mississippian systems are found in outcrop together with a rather considerable basal portion of the Pottsville in the eastern part of the county. Alluviated sediments of fluvial origin consisting of sands, clays and silts of Recent and Pleistocene age compose the flood plains of the Cumberland River and its major tributaries.

The structural attitude of Pulaski County is monoclinal, the normal dip being slightly east of south from the Cincinnati Arch into deeper portions of the Eastern Kentucky Geo-syncline. The county is traversed by a number of anticlines usually of southeastward plunging characteristic, but faulting of considerable significance is unknown.

The principal mineral resource of Pulaski County is limestone which occurs in unlimited quantities widely distributed throughout the central and western portions of the district. These calcareous beds are found in suitable quantity for highway, railroad bed, and general building construction. Certain units of the Mississippian series are sufficiently pure to be used for agricultural lime, and Portland cement material; and for fluxing purposes in the metalliferous industry. Of secondary importance but of great value are the inter-conglomerate coals, two in number, which come to outcrop along the waters of the Rockcastle River and its tributaries in the eastern part of this district. These coals have been operated to some extent for many years for local purposes, but being removed from lines of rail transportation are not exported at the present time. Some years ago, however, a considerable tonnage of coal was removed from Pulaski County and barged down the Cumberland River.

Pulaski County is underlain by Devonian sediments, including the well known Corniferous oil "sand." Petroleum and natural gas have been secured in small quantities, from this horizon as well as from higher Mississippian and Lower Ordovician beds, particularly on the waters of the Rockcastle River and Fishing Creek. Large commercialization of these two mineral fuels, however, has not been developed, though the county seat of Pulaski County, Somerset, gives its name to the general grade of eastern Kentucky produced petroleum.



ALONG THE SOMERSET-BURNSIDE PIKE.

Roadside outcropping rocks are limestones of Lower Carboniferous age. A new grade has been established here on the Lookout Mountain Air Line.

Clay suitable for brick and tile making of both alluvial and residual characteristic are available in Pulaski County; and sands and gravels suitable for general construction may be taken from both the Rockcastle and Cumberland rivers. Some amounts of galena and sphalerite have been reported from this district, but not in sufficient quantities to assure commercialization. Calcite and barite are also known to occur as minor deposits in this region.

Pulaski County was mapped geographically showing mineral development for oil, gas, coal and limestones in 1924 and published in 1925. A new areal and structural geological map of Pulaski County was surveyed in reconnaissance to the scale of one inch to the mile in 1928. The eastern portions of this area have been mapped, topographically, on the London and Williamsburg quadrangles, scale 1:125,000, with a contour in-

terval of 100 feet. The central and southern parts of the county are shown on the Somerset, Burnside, and Monticello quadrangles, scale 1:62,500, contour interval 20 feet.

CI.

ROBERTSON COUNTY

Robertson County is located in the Outer Bluegrass of north-eastern Kentucky. It is the smallest county in Kentucky, containing only 106.73 square miles. Its principal drainage is the North Fork of the Licking River. Mt. Olivet, located in the interior upland, is the county seat. It has an elevation of 925 feet



SKETCH OF ROBERTSON COUNTY.

which is representative of the plateau levels in this region. The county is hilly throughout, the drainage being entrenched to a maximum relief of about 300 feet.

The hard rocks of Robertson County consist of Ordovician thin limestones, blue shales, and thin sandstones, beginning in the upper divisions of the Champlainian along the waters of the main North Fork of the Licking River and extending up through the Eden shale and Garrard sandstone of the Cincinnati. The flood plains of the North Fork of Licking River contain some alluviated sediments consisting of sands, clays, gravels and

silts of Recent and Pleistocene age. The structural attitude of Robertson County is that of a monocline dipping sharply to the northeast from a medial position on the northeastern flank of the Lexington Dome of the Cincinnati Arch. Robertson County is flexed by a number of minor folds, but faulting of major significance is unknown.

The principal mineral resource of Robertson County is limestone which occurs in quantity and quality suitable for road building railroad bed and general rural building construction. Clays of both residual and transported characteristic are available for the manufacture of common brick. Wells of medium depth drilled through to the Blue Lick horizon will produce mineral waters of excellent quality. Shallow wells drilled in northern Robertson County may secure small amounts of petroleum as has already been done in southeastern Bracken County; but it is doubtful whether oil or gas will ever be secured in this district in important commercial quantities. Sand deposits in the channel of the Licking River may be used for general construction purposes.

Robertson County was mapped with Nicholas County geographically at the scale of 1 inch equals 1 mile, in 1924. The district has never been surveyed either geologically or topographically except in the vicinity of Blue Licks Springs and Battlefield in which locality field investigations were in progress in 1928. Prints covering the topography of this small area are now available. An areal geological map will be issued in 1929.

CII.

ROCKCASTLE COUNTY

Rockcastle County, situated in central, eastern Kentucky, has an area of about 310 square miles. The western part of the district is contained within the Mississippian upland; while the eastern part of the county tips within the western border of the Cumberland Plateau. Mt. Vernon, the county seat, has an eleva-



LIMESTONE CLIFFS AT BRUSH CREEK STATION.

These massive calcareous beds are of St. Louis age (Mississippian). One flank of an anticline may be seen here. Rockcastle County has a number of similar structures.

tion of 1150 feet, but is exceeded by many surrounding ridges. Isolated knobs and ridge tops rise 1525 feet. Linville Knob near Conway on the head of Roundstone Creek has an elevation of 1575 feet. The minimum elevation of 775 feet occurs on the waters of the Rockcastle River near Pine Creek, giving a maximum relief for the entire district of 800 feet. Local relief averages from 350 to 500 feet. The county is hilly to rugged throughout, the typical hill country being confined particularly to the western part of the district, while the eastern portion presents steep slopes and highlifted hillsides along all drainage lines. The region as a whole is popularly but erroneously described as a part of the "Mountains." Caves, sink holes and underground drainage are rather common features of the topography.

The hard rocks of Rockcastle County exhibit a total sequence of 700 feet of Paleozoic formations in which the Carboniferous groups predominate. The lowest rocks stratigraphically are Silurian limestones. These occur on the waters of Copper Creek in the vicinity of and near the Livingston County line. In ascending order, the entire local Devonian sequence comes to outcrop as does all of the Mississippian System. Only the conglomeratic and included shaly portions of the Pottsville formation are represented in the eastern part of this county, the Corbin conglomerate sandstone being the highest local formation in the Pennsylvanian System.



SPARKS QUARRY NEAR MT. VERNON.

This operation in the Mississippian limestone is one of the largest in Eastern Kentucky. The quarry face measures over 110 feet.

vanian System. Restricted areas of alluviated sediments consisting of sands, gravels, clays and silts of principally Recent deposition occur along the waters of Rockcastle River and its major tributaries.

The structural attitude of Rockcastle County is that of a monocline tilted to the southeast from a medial position on the Cincinnati Arch, the normal dip being sharply down into the Eastern Kentucky Geo-syncline. Rockcastle County, however, is flexed by a number of anticlines and synclines throughout. The central portion is normally faulted by the Mt. Vernon disturbance which exhibits a maximum throw of about 80 or 90 feet. Downthrow is on the north side of this angulated break. In the

vicinity of Livingston on the Rockcastle River there exists a considerable irregularity in which both dynamic and sedimentary factors are involved, giving rise to very complex relationships.

The principal mineral resources of Rockcastle County are limestones, sandstones and coal. The limestones occur in a broad belt stretching southwestward from the head of Clear Creek through Mt. Vernon and on to the head of Skeggs Creek. This calcareous area includes the central western part of the county. The calcareous formations exposed are principally Upper Mississippian in age and present suitable grades of limestones for high-



THE MT. VERNON-RICHMOND ROAD.

The topography seen here is typical of northern Rockcastle County where Mississippian sediments are chiefly in outcrop.

way, railroad bed and general building construction. Certain beds might be used for agricultural lime, and others are sufficiently pure for fluxing purposes in the metallurgical industry. Mississippian limestones also outcrop along the waters of Rockcastle River on the headwaters of Brush and Roundstone creeks where they may be easily opened up on many elifted hillsides. In the northwestern part of Rockcastle County along the drainage of the Clear, Roundstone and Brush creeks, Lower Mississippian sandstones of the "Blue Stone" variety (Cuyhoga formation) outcrop and are operated for general building construction, particularly exterior work.

The bituminous coals of Rockcastle County are several, but two benches, the sub-conglomerate and the interconglomerate,

are of high by-product value and have been operated to a considerable extent. During 1926 a considerable tonnage of coal was mined for local and domestic use, and some years ago coal was produced from Brush Creek for export by rail. Sands suitable for general building purposes occur both as transported and residual sediments in this district, and clays transported and residual characteristic, suitable for ordinary brick making, are available. Oil and gas in small quantities have been secured in a number of indexing wells, but up to the present time have not been commercialized.

This district along its central faulted area is known to exhibit small amounts of galena, sphalerite and calcite. Considerable amounts of barite are also reported along this disturbance. None of these minerals are commercialized at the present time.

A detailed geological, oil and gas map was prepared in 1927 of the Kentucky Geological Survey at the scale of 1 inch equals 1 mile. This was preceded by a soil map of this county which was prepared in 1910 at the same scale. The topography of this district is presented on the London and Richmond quadrangles, scale 1:125,000, contour interval 100 feet.

CIII.

ROWAN COUNTY

Rowan County is situated in the Knobs Belt of northeastern Kentucky. It contains about 272 square miles and is drained by the North Fork of Licking River. Morehead, the county seat, located on the flood plain of Triplett Creek, the major line



FIRE BRICK PLANT AT HALDEMAN.

Rowan County exhibits as one of its great mineral resources excellent flint fire clays. Many of these deposits remain yet to be made commercial by extension of transportation.

of drainage within the district, has an elevation of 700 feet. Isolated forested knobs and winding ridges adjoining, however, rise 300 and 400 feet higher. Physically the region is in a state of mature dissection throughout, except in the vicinity of the Elliott County line. Here flat to undulating uplands of Craney Creek, flowing through a precipitous gorge trenched in the Pottsville conglomerate, still preserve the aspect of late youth.

The hard rocks of Rowan County consist of a considerable sequence of Paleozoic sediments, the lowermost of which are Silurian limestones and shales. Above these there come to outcrop successively all of the local sequence of shales, limestones, and sandstones of the Devonian and Mississippian systems. Isolated outliers of the conglomeratic phase of the basal Pennsylvanian (Pottsville) cap some of the hills and ridge tops in cen-

tral eastern Rowan County; while the southeastern part of this district is embraced well within the Cumberland Plateau, and exhibits only Coal Measure formations. The valley bottoms of the North Fork of Licking River and its principal local tributary, Triplett Creek, show alluvial sediments—sands, gravels and clays of fluvial origin, Pleistocene and Recent in age. The structural attitude of the bedded rocks of Rowan County is that of a monocline dipping pronouncedly into the Eastern Kentucky



A ROWAN COUNTY FREESTONE QUARRY.

This rock industry is well developed at a number of points west of Morehead. The beds are of Waverly (Lower Mississippian) age.

Geo-syncline from a medial position on the eastern flank of the Cincinnati Arch. The county is flexed locally into synclinal and anticlinal areas, chiefly of fingering or plunging characteristics. Faults of major significance are unknown.

The principal mineral resources of Rowan County are flint fire clays and building stones. The fire clays, of superior quality and considerable quantity, occur at a uniform horizon at the base of the conglomeratic phase of the Coal Measures just above the Upper Mississippian limestones. These clays are a westward continuation of the flint fire clays produced in Carter County. Though operated to some extent, there are considerable areas of

flint fire clays that are undeveloped in Rowan County. Sandstones occurring in the Cuyahoga formation of the Waverly (Lower Mississippian), of fine and even bedded texture have given rise to a considerable building stone industry in Rowan County. Several quarries are now producing this celebrated "blue stone" or "free stone" as it is commonly called. Large areas showing on outcrop a continuation of these operated sandstones, are available in Rowan County.

A considerable number of wells were drilled for oil and gas a few years ago in the valley of the North Fork of the Licking River, particularly in the Ragland Oil Pool. Oil of low gravity was produced at shallow depths from the Corniferous (Devonian) limestone. In the vicinity of Morehead and northwestward several shallow indexing natural gas wells have been drilled and some are producing, the horizon being the Corniferous (Devonian) limestone. Large untested areas exist in this district. Clays and clay shales of residual and transported character suitable for the manufacture of brick and tile are widely distributed throughout Rowan County. Creek sands and gravels suitable for building construction exist. Residual sands are available in this district for building purposes. Limestones of inexhaustible quantity and quality are available suitable for highway, railroad bed, and rural building construction. Some of these calcareous formations, selected for their purity, might be used for agricultural lime, and others for fluxing purposes in the metallurgical industries. Calcareous marls are reported in unknown quantities suitable for use as agricultural fertilizer. The central and western part of Rowan County is marked by the outcrop of the Chattanooga (Devonian) shale which will afford at some future time a source for the production of immense quantities of artificial petroleum.

Rowan County was mapped geographically for oil and gas in 1925 at the scale of 1:62,500, but the detailed geology of this region has never been executed. The topography of central and southeastern Rowan County is available on the new Morehead Quadrangle now available in photolithograph at the field scale of 1:48,000.

CIV.

RUSSELL COUNTY

Russell County is situated in the southern-central part of Kentucky toward the eastern edge of the Pennyroyal district. It contains about 329 square miles. Jamestown, the county seat, has an upland elevation of 950 feet, but ridges in the vicinity of the Casey County line are somewhat higher and the Mintonville Knob near the Casey-Pulaski corner is the highest in this vi-



CUMBERLAND RIVER VALLEY.

In Russell County from Mill Creek to the Pulaski County line excellent farms founded principally on transported soils follow the master stream.

cinity. The drainage of the district falls into the Cumberland River through Wolfe, Lily, Greasy, Mill and Indian creeks. The western part of the county is drained by the headwaters of Russell Creek, a northeastward flowing tributary of the Green River. The greater part of Russell County is a rolling to hilly upland plain. The southern part is deeply trenched by the Cumberland River.

The hard rocks of Russell County, limestones, shales and shaly sandstones, show a considerable sequence of Paleozoic sediments beginning with the uppermost divisions of the Cincinnati (Ordovician), extending upward through the entire local sequences of the Devonian and Mississippian systems. Patches of disintegrated residual Pottsville conglomerate sandstones (Pennsylvanian) are occasionally found on the tops of the higher ridges

as on the top of Mintonville Knob. The flood plains of the Cumberland River and some of its major tributaries exhibit alluvial sediments consisting of sands, gravels and clays of Recent and Pleistocene age.

The structural attitude of the bedded rocks of Russell County is monoclinal, the dip being pronouncedly to the southeast for a medial position on the eastern flank of the Cincinnati Arch. Two small normal faults with northern strike exist near and overlap the Casey County line.

The principal mineral resource of Russell County is limestone which occurs in inexhaustible quantity widely distributed throughout the district. Tests indicate many beds are suitable for highway, railroad bed and general rural building construction. Some grades of limestone in Russell County might be used for agricultural lime, and others for cement material and for fluxing purposes in the metallurgical industries. Due to the fact that this county is without railroad transportation, no limestone tonnage is prepared for export. Sands suitable for various purposes occur in selected localities in the bed of the Cumberland River. Clays suitable for common brick and tile manufacture exist in this district both as alluvial and residual deposits. A number of wells have been drilled in the southern part of Russell County, particularly near Creelsboro, and have indexed small amounts of oil and gas. Several mineral springs of recognized value occur in this region particularly in the vicinity of Russell Springs.

Russell County was mapped geographically in 1924 at the scale of 1 inch equals 1 mile, but the detail of its geology has never been executed. The southeastern quadrant of the county on the lower waters of Wolfe Creek in the Cumberland River has been topographically surveyed on the Monticello Sheet, scale 1:62,500, but the remainder of the county is unmapped topographically.

CV.

SCOTT COUNTY

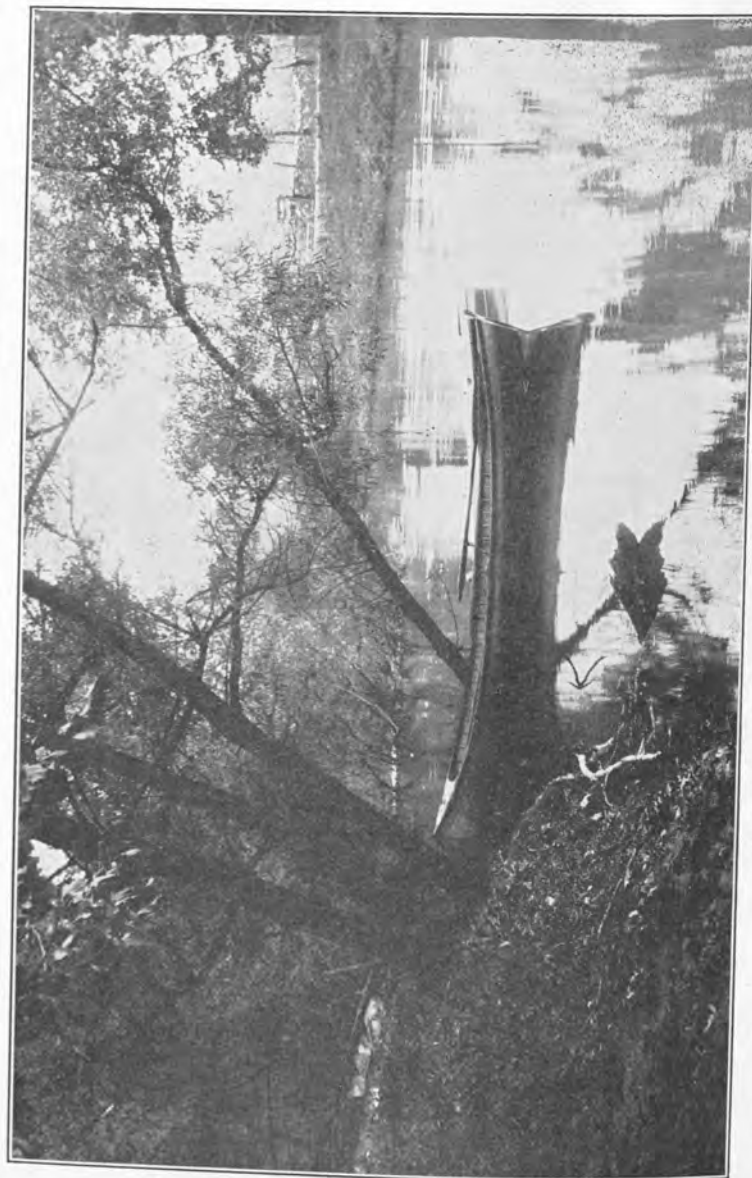
Scott County is situated in the heart of the Bluegrass Region of Kentucky. Areally it is of medium size covering about 289 square miles. The southern portion of this county, a gently undulating plain, is included geographically within the Inner Bluegrass, while the northern half of the county, hilly and maturely dissected, is definitely a part of the Outer Blue-



FAULTED ORDOVICIAN LIMESTONES, GEORGETOWN.
This very evident displacement occurs in a cut of the Southern Railroad just at the north edge of the city. Willard Jillson, Jr., holds hammer at fault plane.

grass Region. Georgetown, exhibiting various elevations ranging from 860 to 900 feet above sea level, is the county seat of Scott County, and is located in a great meander of the North Fork of Elkhorn Creek. Ridges to the north along the divide between Licking River and Eagle Creek rise to more than 1,000 feet.

The hard rocks of Scott County consist of a considerable sequence of Ordovician sediments, principally limestones, shaly limestones and shales. The southern part of the district exhibits in the valley and upper waters of Elkhorn Creek highly phosphatic limestones Champlainian in age, while the southern part of the district presents principally the Eden shale and other



NORTH ELKHORN CREEK NEAR GEORGETOWN. Elkhorn, widely famed for its beauty since Colonial days is the exquisite at many points in Scott County. Nature herself is in a conspiracy with all of the arts when she moulded the Bluegrass meadowland in Tertiary time and then as a finishing touch threaded the graceful meanders of the limpid Elkhorn through it to delight and fascinate men for all ages.

adjacent calcareous members of the Cincinnati (Upper Ordovician). The valley bottoms of North Elkhorn Creek on the south and Eagle Creek on the north are thinly spread with alluviated sediments of Recent age.

The structural attitude of the bedded rocks of Scott County is monoclinal, the dip being to the north and northwest as might be inferred from the high position of this county on the northern



BLUE SPRING.

One of the large and really remarkable springs of Central Kentucky is this one on the Stamping Ground pike. Vice President R. M. Johnson once conducted an Indian School here.

apex of the Lexington Dome of the Cincinnati Arch. A number of minor anticlines fingering in various directions have been noted in this district. In the western part of the county following somewhat the course of North Elkhorn Creek two normal faults of pronounced feature strike northwestwardly toward Peaks Mill in Franklin County. These fractures have a considerable displacement, developing a well defined graben of elongate figure enclosing the Eden shale between much older beds.

The principal mineral resource of Scott County is limestone which occurs in inexhaustible quantities suitable for highway and railroad bed construction. Some massive limestones in the southern part of the district and other thinner platy limestones in the northern division of this area are used for local building construction. Clays of residual characteristic are available for

the manufacture of common brick, and it is probable that some deposits of phosphatic limestones might be found in the southern part of this county which would be suitable for industrial use.

The soils of Scott County were mapped in 1903. Subsequently in 1923 a geographic map was prepared for this district and published. The topography of the southern part of Scott County is presented on the Georgetown and Lexington quadrangles scale 1:62,500, but the northern part of the district is unsurveyed topographically, except for a narrow strip along the Harrison County border shown on the new Cynthiana Sheet at the field scale of 1:48,000. The detailed geology of the Georgetown Quadrangle was published in 1913.

CVI.

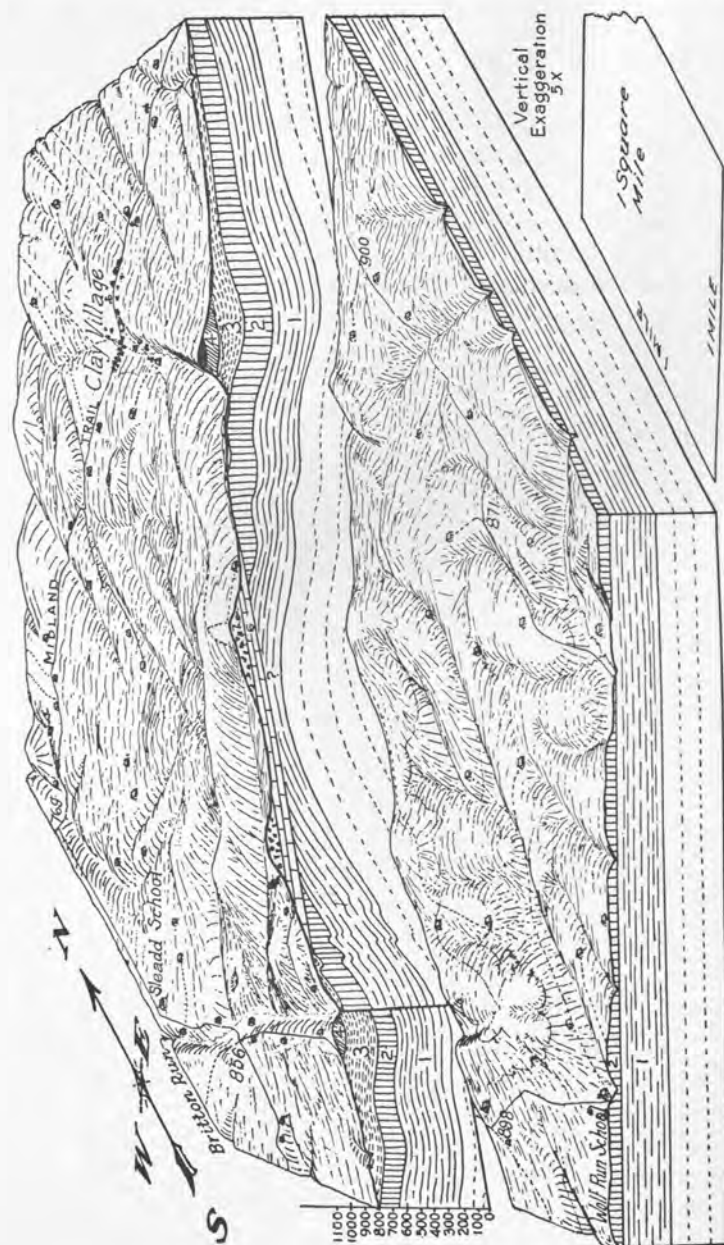
SHELBY COUNTY

Shelby County is situated in northern Kentucky in the Outer Bluegrass Region. Covering about 427 square miles it is grouped with the larger counties. The terrain of this district varies from rolling to hilly, the central northern portion of the county from Shelbyville northward to the vicinity of Pleasureville being the least dissected. As a whole the district is a plateau mature throughout, dropping from elevations of about



JEPHTHA KNOB FROM THE MIDLAND TRAIL.
Capped with cherty Silurian limestones this Knob exhibiting an elevation of 1163 feet is easily the highest in north Central Kentucky.

900 feet on the east to about 800 feet on the west. Shelbyville, the county seat, has an elevation of 761 feet and is representative generally of the upland levels. Jephtha Knob, near Clay Village, has an elevation of 1163 feet and is the highest point not only in Shelby County but in the entire Bluegrass Region. The minimum elevation in Shelby County of 620 feet occurring on the waters of Salt River at the Spencer County line, indicates a maximum relief for this district of 543 feet, though the usual local relief varies only from 100 to 150 feet. The county is drained principally by Bradshear and Big Beach creeks of the North Fork of Salt River, but a small amount of drainage falls into the Kentucky River through North Benson Creek on the east, while Long Run and other tributaries of Floyd's Fork of the Salt River drain the western part of the county. The northeastern tip of this district is drained by Six Mile Creek, a north-eastward flowing tributary joining the Kentucky River at Lockport.



BLOCK DIAGRAM OF JEPHTHA KNOB.
Both the physiographic and structural features of this unusual outlier of the Silurian are well illustrated in this drawing by A. K. Lobeck.

The hard rocks of Shelby County consist almost entirely of Ordovician limestones, sandstones, shales, principally of the Maysville and Richmond formations. The Eden shale outcrops along the entire eastern boundary and on the waters of Salt River. The top of the Jephtha Knob is capped by an outlier of Silurian limestones, and these beds are also to be seen in the northwestern part of the county between Long Run and Floyd Fork. Alluviums filling the bottoms of the major lines of drainage consist of angular cherty gravels, silts and clays all of Post-Pleistocene origin.

The structural attitude of Shelby County is monoclinial, the dip being pronouncedly to the northwest from a medial position on the Lexington Dome of the Cincinnati Arch. Minor flexures are recognizable at various points as anticlines and synclines, while in the vicinity of Clay Village a cryptovolcanic faulted structure is responsible for a most remarkable mondanock—Jephtha Knob.

The principal mineral resource of Shelby County is limestone which occurs in quantity and quality adequate for any reasonable demands for highway, railroad bed and general rural building construction. Some residual clays in this district are suitable for ordinary brick making. Wells drilled to medium depths in the underlying Ordovician sediments will produce the well known Blue Lick mineral water.

A soil map of Shelby County, scaled 1 inch equals 1 mile, was published in 1916. The topography of the southern, western, and eastern parts of this district has been presented on the LaGrange, Taylorsville, Mt. Eden, Frankfort and Lockport quadrangles at the scale of 1:62,500. The Eminence Quadrangle lying north of the Mt. Eden Quadrangle has not been completely surveyed, but the Shelby County portion has been completed. The detailed geology including a map scaled 1:62,500 has been prepared for the Jephtha Knob region, but Shelby County as a whole has not been made the subject of a detailed geological survey. A reconnaissance geological map of Shelby County with Henry was published in colors at the scale 1 inch equals 2 miles by the Second Geological Survey of Kentucky. This map and the brief report accompanying it are now out of print and rare.

CVII.

SIMPSON COUNTY

Simpson County, a typical part of the Pennyroyal, is situated in southern Kentucky adjacent to the Tennessee line. It covers about 216 square miles. The district is undulating to hilly throughout, the central and western portion of the county exhibiting a pronouncedly Karst topography. Sink holes and sub-



THE PENNYROYAL PLAIN NORTH OF FRANKLIN.

Much good farm land sourced from thick Mississippian limestones, is to be found between Franklin and Bowling Green. This view shows the W. B. Lewis plantation in Simpson County.

terranean drainage are characteristic of this portion of the district. The region about Franklin, the county seat, which has an elevation of 700 feet above sea level, is representative of the soluble limestone plateau of this part of Kentucky. The principal drainage of Simpson County falls into the West and Sulphur Forks of Drakes Creek, a north flowing tributary of Barren River. A small amount of drainage in the northwestern part of this county, however, finds its way into Clear Fork of the Gasper River. Normal relief is about 75 or 100 feet though greater variations occur. The minimum elevation, 500 feet, occurs on West Fork at the Warren County line.

The hard rocks of Simpson County consist of massive limestones, thinner sandy shales and shales of the Mississippian series. The principal formation in outcrop is the St. Louis limestone. Beds high in the Osage series (basal Mississippian) occur

in the waters of Thompson Branch of West Fork and along the waters of Sulphur Fork, while a small outlier of the Chester series occurs on Pilot Knob a few miles southeast of Auburn in the northwestern part of Simpson County. Relatively thin deposits of fluvial silts and clays of Recent age are found in the bottoms of the principal lines of drainage. The structural attitude of Simpson County is monoclinal, the dip being to the northwest toward the Western Kentucky Coal Field. Minor structures of anticlinal and synclinal type are found at numerous points throughout this county, but neither major faulting nor folding is known to occur in this district.

The principal mineral resource of Simpson County is limestone which is available in quantity and quality entirely adequate for road building, railroad bed, and general building construction purposes. Some limestones of Simpson County might also be used for agricultural lime. Some residual clays are available here for ordinary brick making purposes. A considerable amount of petroleum and some natural gas have been secured from drilled wells at various points throughout the county, production coming chiefly from the basal Mississippian and the Corniferous (Devonian) limestones just beneath the Chattanooga shale. The most important oil producing areas are known as the Pugh Pool, on the Morgantown Pike near the Logan-Warren County line, the Reeder Pool on West Fork two and a half miles northeast of Franklin, and the Crowds Pool near Flat Rock about three miles southeast of Franklin.

Simpson County was mapped for oil and gas at the scale of 1 inch to 1 mile in 1925. The topography of the eastern part of the district is shown on the Bowling Green and Buck Lodge sheets, scale 1:62,500, contour interval 20 feet.

CVIII.

SPENCER COUNTY

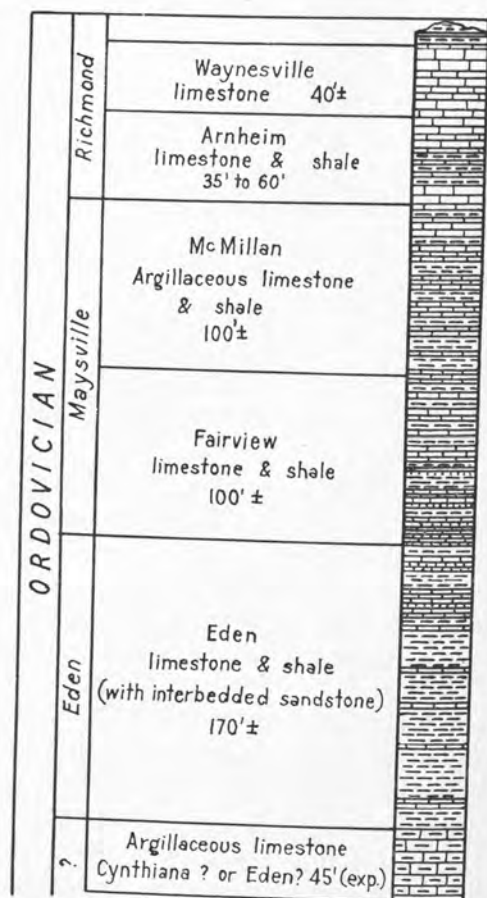
Spencer County, a part of the Outer Bluegrass, is located in central northern Kentucky. It is one of the State's smaller units containing only 196.2 square miles. The district is one characterized by mature topographic features, the ridge lands being equivalent to the Lexington Plain of Tertiary times. Taylorsville, the county seat, on the flood plain of the North Fork of Salt River, has an elevation of 490 feet, but uplands surrounding rise to 750 and 800 feet. Minimum elevations of 440 feet occur on the North Fork of Salt river near Smithville at the Bullitt County line. Maximum elevations of 850 feet are found on the ridge tops in the vicinity of Mt. Eden, giving a maximum relief of 410 feet. The normal local relief is generally about 150 or 175 feet.

The hard rocks of Spencer County are limestones, sandstones and shales all of Ordovician age. Beds correlated with the Maysville and Richmond formations make up the ridges, while the bedded rocks in creek and river bottoms are the Eden shale and Garrard limestone. Fluvial silts and clays of Recent origin make up the flood plains of the principal line of drainage, the North Fork of Salt River and its local major tributaries. The general structure of Spencer County is monoclinal, the dip being to the west from a medial position on the western flank of the Lexington Dome of the Cincinnati Arch.

The most important mineral resource of Spencer County is limestone which occurs in adequate quantity and quality for highway, railroad bed and general rural building construction. Clays of residual and transported character are available for the manufacture of common brick. Blue Lick sulphur mineral waters might be secured in drilled wells of medium depth.

The geology of Spencer County with Nelson was published on a reconnaissance map in colors, scale one inch equals two miles in 1884, but is now exhausted in edition. A new geographic map of the county was surveyed and published with detailed strati-

GENERALIZED STRATIGRAPHIC SECTION FOR SPENCER COUNTY, KENTUCKY



After A.C. McFarlan

STRATIGRAPHIC SECTION FOR SPENCER.

graphic section, by the Geological Survey in 1928. The topography for the northern part of this district has been surveyed on the Taylorsville, Louisville, and Mt. Eden quadrangles, 1:62,500, contour interval 20 feet.

CIX.

TAYLOR COUNTY

Taylor County, situated in central Kentucky on the headwaters of Green River, is typical throughout of the eastern Pennyroyal Region. It embraces 359 square miles. Mature dissection has resulted in presenting a terrain which is conspicuously hilly, level lands being small in extent and entirely restricted to the bottoms of the Green River, the major line of drainage. Campbellsville, the county seat, has an elevation of 800 feet, but ridges surrounding rise from 100 to 150 feet higher.

The hard rocks of Taylor County consist of a sequence of Paleozoic limestones, sandstones and shales beginning with a very small inlier of the Cincinnati (Ordovician) and extending up through the overlying Chattanooga (Devonian) black shale, and the local sequence of the Lower and Middle Mississippian System. While beds of Chester (Mississippian) age are absent, some irregular representatives of the lower conglomerates of the Coal Measures (Pennsylvanian) are present. The Ordovician and Devonian outcrops are found only in the headwaters of Robinson Creek in the northeastern part of the county. Limestones of Osage (Mississippian) age are exposed over the central and southern portions of the county, while beds of the St. Louis (Meramec) are confined to the west and northwest. The Pennsylvanian sediments, consisting of thin, greatly eroded outliers, occupy isolated ridge top positions on the head of drainage adjoining the Larue County line. The flood plain of the Green River traverses the southern part of the county and this stream with its principal local tributaries, Robinson Creek and Pitman Creek, exhibit fluviatile sediments of post-Pleistocene age.

The structural attitude of Taylor County is monoclinial, the normal dip being slightly south of west from a low position on the southwestern flank of the Lexington Dome of the Cincinnati Arch. Outcrops variously distributed throughout the county indicate the occurrence here of a number of minor flexures in the form of anticlines and synclines, but major faulting or folding is unknown.

The principal mineral resources of Taylor County are limestones and natural gas. The limestone occurs broadly distributed and is found in quantity and quality suitable for highway, railroad bed, and rural building construction. Natural gas is produced from the Corniferous (Devonian) limestones from wells of shallow depth ranging from 450 to 700 feet. These wells exhibit an important open flow capacity ranging from 500,000 cu.



WAYNE GAS WELL.

This drilling when flush produced in excess of 2,000,000 cubic feet daily. It is located west of Campbellsville on anticlinal structure.

ft. to 1,500,000 cu. ft. but have a rather low rock pressure seldom in excess of 38 pounds. Taylor County produces natural gas which is used locally for domestic purposes and for the manufacture of carbon black. Residual and transported clays in this district are available for the manufacture of common brick. Isolated ridge top patches of residual conglomerates might be made productive of gravels suitable for rural road construction.

Taylor County was mapped for oil and gas, scale one inch equals one mile, in 1925, but neither the detailed geology nor the topography of this district has been surveyed. A map outlining a reconnaissance soil survey of this district, scaled one inch equals two miles, was published without date by the Third Geological Survey prior to 1912.

CX.

TODD COUNTY

Todd County, typical of the Pennyroyal Region of which it is a part, is situated in southern Kentucky adjacent to the Tennessee line. It is grouped with the medium sized units of Kentucky upon an areal basis of about 367 square miles. The county is drained by the headwaters of Mud and Gasper rivers on the north, and the Red River on the south. Elkton, the county seat, has an elevation of about 600 feet, and is representative in character of the undulatory Mississippian Plateau in this part of the State. The northern part of the county exhibits a naturally dissected characteristic with a maximum relief of 350 feet.



TOPOGRAPHY NEAR ALLENSVILLE.

Much of Central Todd County is broadly undulating with Karst characteristic.

Local relief varies from 100 feet in the central upland areas of the county to 250 feet in regions of deeper trenching such as on Rocky Clifty Creek near the Logan County line.

The hard rocks of Todd County, all of Carboniferous age, consist of the Middle and Upper sequences of Mississippian limestones, sandstones and shales upon which are found superimposed in the northeastern part of this area the basal sandstones, sandstone conglomerates, shales and thin coals of the lower Coal Measures—Pottsville (Pennsylvanian). The line of contact between the Meramec and Chester divisions of the Mississippian nearly bisects the county striking slightly north of west somewhat irregularly a few miles south of Daysville and Elkton. Al-

luvial sediments of fluvial origin occur in the lower waters of the streams and are probably all post-Pleistocene in age.

The structure of Todd County is monoclinal, the dip being nearly due north into the geo-syncline of the Western Kentucky Coal Basin. Minor flexures occur throughout the county,



FALLS AT SILVER SPRINGS, TODD COUNTY.

This locality on the upper waters of Pond River is about ten miles north of Elkhorn. Chester beds are at the surface.



CHESTER LIMESTONE ON ELK FORK WATERS.

but faulting of major significance is unknown. Considerable local faulting of a generally east and west trend is strongly suspected within the Chester and Pottsville areas, particularly in the vicinity of the periphery of the Western Kentucky Coal Field.

The principal mineral resource of Todd County is limestone which is available in quantity and quality adequate for any rea-

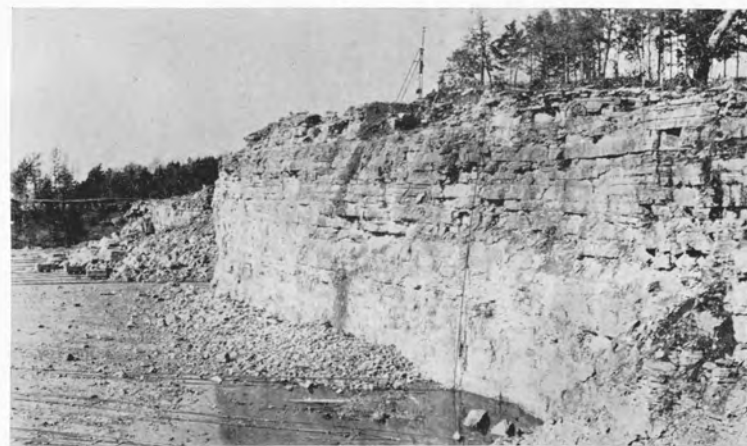
sonable demands of highway, railroad bed, and general building construction. Certain beds of oolitic limestone (Gasper age) in the northern part of Todd County though removed from lines of rail transportation are of very superior quality for building purposes. Residual clays in Todd County are available for the manufacture of common brick, and in the northern part of the district disintegrated residual conglomerates are productive of gravels suitable for rural highway construction. The coals of Todd County are inconsiderable from a standpoint of export, though some of them might be used for domestic purposes.

Todd County was mapped geographically in 1924 at the scale of one inch equals one mile. The topography of the county is shown on the southern portion of the Nortonville and Drakesboro quadrangles, scale 1:62,500, contour interval 20 feet. These sheets were published in 1912 and 1913. No detailed geological survey of this district has been made.

CXI.

TRIGG COUNTY

Trigg County, one of the westernmost units in the Pennyroyal area, is located in southwestern Kentucky adjacent to the State of Tennessee. It has an area of 462.01 square miles. Physiographically, the district is rolling in the eastern and northeastern parts, but becomes pronouncedly hilly in the west. A char-



LIMESTONE QUARRY AT CERULEAN.

Trigg County's greatest mineral resource is limestone. This quarry in oolitic and compact beds of Mississippian age is one of the largest in Western Kentucky.

acteristically Karst or sinkhole topography with many sinking streams, ponds, and big springs is found northeast of Little River in the vicinity of Montgomery and Wallonia. Cadiz, the county seat, located on Little River, has an elevation of 400 feet above sea level. The county is drained principally by the Cumberland River which traverses along a northwestward line of flow the central western portion. Little River and Mud Fork are its principal local west flowing tributaries. The Tennessee River is the western boundary of Trigg County separating it from the Jackson Purchase Region.

The hard rocks of this district are restricted almost entirely to limestones of Meramec (Middle Mississippian) age. The St. Louis is the most conspicuous but the Fredonia, Spergen and Warsaw are also present. Beginning at Cerulean with a few outliers, Chester limestones and sandstones set in and extend north-eastwardly across the Christian County line. Ridge lands between the Cumberland and Tennessee rivers exhibit an extended and continuous outcrop of Cretaceous unconsolidated sand and gravel outliers. These beds are correlatives of the somewhat smaller upland gravels east of the Cumberland River and west of Cadiz. These soft Cretaceous sediments are of Eutaw and Tuscaloosa age. The flood plains of the Tennessee and Cumberland rivers, and their local tributaries are composed of sands, gravels, clays and silts of Recent and Pleistocene age. Small fluvial boulders of quartzite on the upper bottoms of the Tennessee River exhibit many glacial striations.

The structural attitude of the bedded rocks of this district is geo-anticlinal, the crest of the Kuttawa Arch striking south-eastwardly from the great bend of the Cumberland River toward the Tennessee line between the Cumberland River and Cadiz. Because of this major fold, the rocks in northeastern Trigg County dip pronouncedly to the northeast, while those west of the Cumberland River plunge to the southwest. The northern part of the district is somewhat complexly faulted along lines of generally east and west strike, as are adjacent areas in Christian, Caldwell and Lyon counties.

The principal mineral resource of Trigg County is limestone, which occurs in quality and quantity adequate for highway, railroad bed and rural building construction. Some grades of Trigg County limestone may be used for agricultural purposes. Others would be suitable for cement materials. The district exhibits considerable deposits of both residual and transported clays which would be of acceptable grade for the manufacture of common brick and tile. Selected river deposited clays in this district might be used with local limestones in the manufacture of Portland cement. Cretaceous areas, particularly in between the rivers west of Cadiz, afford inexhaustible deposits of both sand and gravels for road and general building construction. Lines of normal faulting, particularly in the north-

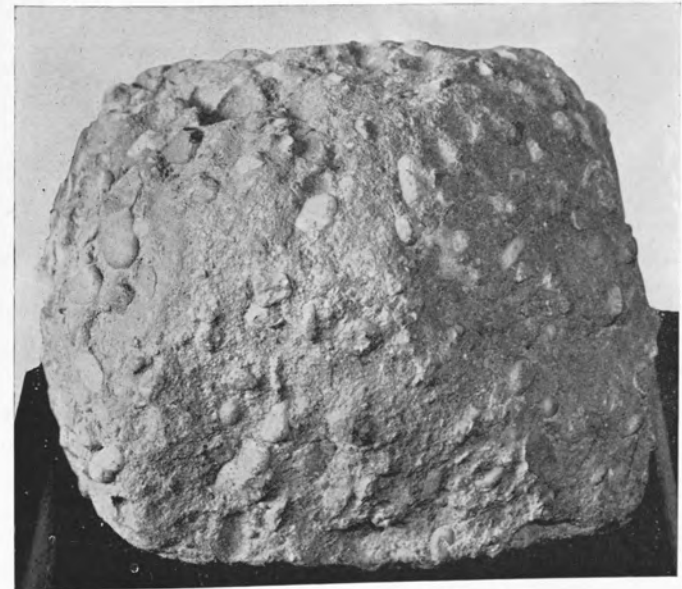
ern and eastern parts of Trigg County, are regarded as a unit with and of similar origin to those traversing the highly mineralized Western Kentucky Flourspar Field. This district exhibits deposits of fluorite, calcite and barite, galenite, sphalerite and other associated minerals. Prospecting has revealed only small quantities of these minerals up to the present time, and these have received practically no commercial attention.

Trigg County was mapped geographically, scale 1 inch equals 1 mile, in 1925. This map was published in 1926. It was previously mapped geologically in reconnaissance prior to 1912 to the scale of 1 inch equals two miles. The district is unsurveyed topographically.

CXII.

TRIMBLE COUNTY.

Trimble County is located in northern Kentucky adjacent to the Ohio River and the State of Indiana. It is small in area, encompassing only about 154 square miles. The district is a part of the Outer Bluegrass Region and is quite maturely dissected. The drainage falls into the Ohio River through Little



ERRATIC GLACIAL BOULDER.

This Jasper conglomerate quartzite, exhibiting at its greatest dimension 15 inches, was found near Bedford, Trimble County, Ky. Its parent ledges are in Canada north of the Great Lakes.

Kentucky River, Pattons Creek, and other smaller westward flowing creeks and branches. Bedford, the county seat, has an elevation of 900 feet and is representative physically of the upland areas. The lowest elevation of about 450 feet is found at the mouth of Pattons Creek and the Ohio River, giving a maximum relief for this district of 450 feet. The usual local relief is somewhat less, however, ranging from 150 to 250 feet.

The hard rocks of Trimble County consist of a sequence of limestones, sandy limestones and shales principally of Cincinnati (Ordovician) age. Limestones and shales of Niagara (Silurian) age occur as outliers of considerable extent on the interior uplands. The bottoms of the Little Kentucky and of the Ohio River are deeply alluviated with sands, gravels, clays, and silts of Pleistocene and Recent age. The northern part of the county has been glaciated and glacial material including sands, gravels and boulders are not uncommon. This district exhibits frequently Canadian sourced metamorphic erratics of the jasper conglomerate type. The structure of Trimble County is monoclinal, the dip being to the northwest from a low flank position on the Lexington Dome of the Cincinnati Arch. Anticlinal and synclinal flexures are recognizable from outcrop, but faulting and folding of major significance are not known to occur in this district.

The principal mineral resources of Trimble County are limestones, sands, and gravels. Limestone is widely distributed and is available in quantity and quality adequate for highway, railroad bed and rural building construction. Sands and gravels in inexhaustible quantities are available from the channel of the Ohio River. Excellent deposits of moulding sands are available for export close to the Ohio River. Beds of clay suitable for cement materials are to be found in alluviated deposits on the Ohio River flood plain. Clays of both residual and transported character, suitable for the manufacture of tile and common brick, are also present. Wells drilled to medium depths into the underlying Ordovician beds might, it is thought, produce mineral waters similar in quality to those found somewhat further to the northeast at Big Bone Lick.

Trimble County was mapped geographically in 1925 to show the Illinoian glacial overlap, but the detail of its geology and topography has never been executed.

CXIII.

UNION COUNTY.

Union County is situated in western Kentucky adjacent to the Ohio River and the States of Indiana and Illinois. It embraces 357.57 square miles. It is the westernmost county in the Western Kentucky Coal Field, and besides the Ohio on the north



OHIO RIVER NEAR UNIONTOWN.

At one time years ago this little village so closely situated in Kentucky above the Wabash was a very important Ohio river steamboat port. Pleistocene and Recent alluviums mantle the surface.

and west, it is drained by the Tradewater River on the south and west. The terrain is rolling to hilly, the only flat lands in the district being confined to the bottoms of the Ohio and Tradewater rivers and Cypress Creek. Morganfield, the county seat, has an elevation of 420 feet above sea level. The local relief generally varies from 50 to 150 feet. A somewhat conspicuous range of hilly uplands, of structural origin, strike southeastwardly across the county from Shawneetown through Chalybeate Ridge to the Webster County line. The district's maximum elevation—660 feet—is found in the hills $2\frac{1}{2}$ miles south of Morganfield. The minimum elevation of the county is found at the juncture of the Tradewater and Ohio rivers, and is 345 feet, giving a maximum relief in this district of 315 feet.

The hard rocks of Union County consist of an alternating sequence of sandstones, sandstone conglomerates, sandy shales, shales and coals all included within the Monongahela, Cone-maugh, Allegheny and Pottsville formations (Pennsylvanian). In a single restricted area along the central portion of the county south of Morganfield the Upper Chester formations are brought to the surface by the Rough Creek disturbance, a faulted and folded structure of regional and economic significance. Sands, clays, silts and some organic deposits of Pleistocene and Recent age compose the flood plains sediments.

The structural attitude of Union County is geo-synclinal, the eastern portion of this geo-syncline being traversed by the pronounced Rough Creek disturbance. In the southeastern part of Union County, the normal dip of rocks is to the north and northeast, while in the northern part of Union County the dip of the hard bedded sediments is to the south and southwest.

The principal mineral resource of Union County is bituminous coal, which is produced from Nos. 1-B (Bell), 5 (DeKoven), 6, 9, and 11 seams. The Geiger's Lake coal—42 inches in thickness—found at the base of the Monongahela formation, is a possible correlative of the well known Pittsburgh seam in Pennsylvania. In 1926 the volume of coal produced for export in Union County was 1,222,406 tons. This district also is underlain with two or three important oil and gas "sands." Oil in commercial quantities has been secured in the waters of Highland Creek near the point crossed by the Illinois Central Railroad at depths ranging from 600 to 800 feet in what has been regarded as the Cypress sandstone. Clays suitable for ordinary brick making are present in this district both as residual and as transported deposits. The Ohio River affords an inexhaustible source of sand and gravel.

Union County has been completely mapped topographically to the scale of 1:62,500 with a contour interval of 20 feet on the New Haven Shawneetown, Morganfield, Sebree, Providence and Uniontown quadrangles. A soil map scaled 1 inch equals 1 mile was published in 1902. A geological and structural map was prepared and published on the Shawneetown quadrangle by the Fourth Geological Survey. A new oil and gas geological map of Union County was prepared and published in 1928. No



NATURAL ROAD CUT IN ALLUVIUM.

Transported sediments unconsolidated and easily eroded are thick along the Ohio River even at some distance back in Union County. Here at a point 2 miles from Uniontown soft sands, gravels and muds are deeply trenched by a cross country pike.

unit report on the geology of Union County has been prepared, though the resources, structure, and stratigraphy of this district are described by separate references in a large number of general geological reports.

CXIV.

WARREN COUNTY.

Warren County is located in central southern Kentucky in the type Karst-Pennyroyal district. Areally it covers about 530 square miles. It is drained by the Barren and Green rivers and their local tributaries. Bowling Green, the county seat, has an elevation of 509 feet, but hill lands in the northern part of the county rise to 740 feet. The maximum knob elevation in the central part of this limestone plateau region is 810 feet. The



THE DRIPPING SPRINGS ESCARPMENT.

The view is northward across sink pitted limestone meadows in the vicinity of Bowling Green.

minimum elevation found at the juncture of the Barren and Green rivers is 412 feet, giving a maximum relief of 398 feet. The normal local relief rarely exceeds 200 feet and frequently in the Plateau-Karst area is less than 100 feet.

The hard rocks of Warren County consist principally of Mississippian limestones, with a few intercalated shales and shaly limestones, all of Mississippian age. The principal formation at outcrop is the St. Louis, but the Chester limestones of oolitic character are found in the northern part of this district. Restricted areas adjacent to the Green River in Warren County exhibit a group of outliers of the basal Pottsville (Pennsylvanian). Sands and clays of alluvial character and principally post-Pleistocene origin are found composing the flood plains of the major lines of drainage.

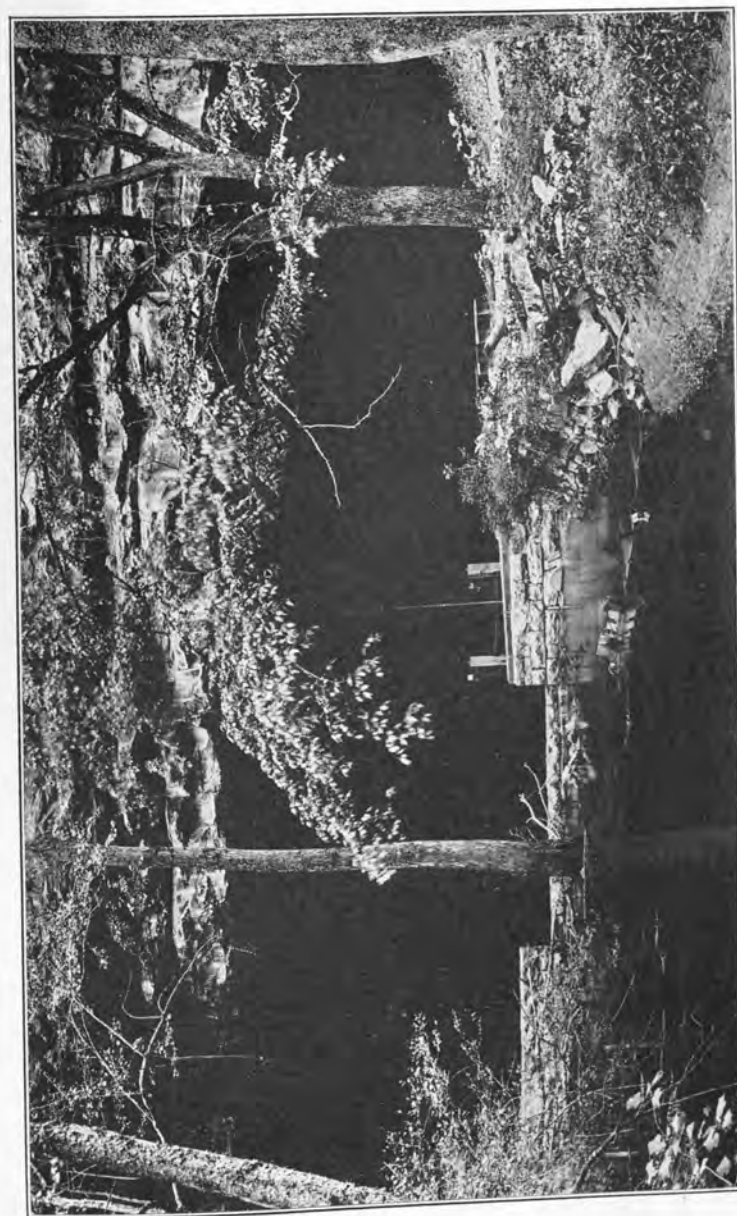
The structural attitude of Warren County is monoclinal, the dip being to the northwest toward the central geo-syncline of the Western Kentucky Coal Basin. The county exhibits a number of flexures of anticlinal and terracing type, and in the northern part of this district in the vicinity of Richardsville and the Green River, there are a number of normal faults of northeast-southwest, and northwest-southeast strike.



POTTSVILLE ASPHALTIC SANDSTONES.

Restricted areas of the basal Coal Measures in the northern part of Warren County exhibit various grades of rock asphalt.

The principal mineral resources of Warren County are petroleum and limestones, though restricted deposits of high grade asphalt give excellent promise of importance. The petroleum produced in this district is secured from two "sands:" (1) in the Warsaw formation at the base of the Mississippian rocks, and (2) in the Corniferous (Devonian) limestone immediately underlying the Chattanooga black shale. During 1924, 580,224 barrels of oil were produced in Warren County, valued at \$1,011,858.99. Limestone suitable for highway, railroad bed and both rural and urban construction is available at many points in this district. The most important building stone is the Gasper oolitic limestone found in the vicinity of Bowling Green, and at many other points throughout the central and northern parts of this county. Some grades of Warren County limestone would be well adapted to use as agricultural fertilizer,



"LOST RIVER" IN THE VICINITY OF BOWLING GREEN.
The greater part of Warren County is typically "Karsit"—studded with sinks ponded and dry. This feature of underground drainage has been widely commented upon by travellers.

while others would combine well in the mixture of cement materials.

Asphaltic impregnated conglomeratic sandstones of Pottsville age occur in a restricted area bordering the Green River in the northern part of this county. While none of these asphaltic deposits are operated at the present time, several of them are of excellent quality and are otherwise of high commercial grade, being immediately available to river transportation.

A soil map of Warren County was published in 1904 at the scale of 1 inch equals 1 mile, and a reconnaissance geological map of Warren County was published in colors at the scale of 1 inch equals two miles, by the Second Geological Survey in 1891. A reconnaissance oil and gas map was issued in 1919 but is now exhausted in edition. A new oil and gas map of Warren County, scaled 1:62,500, has been surveyed and will be published in colors late in 1928. Topography for the north and southeastern parts of Warren County is available on the Little Muddy, Brownsville, Mammoth Cave, Scottsville, and Bowling Green quadrangles, scaled 1:62,500, contour interval 20 feet.

CXV.

WASHINGTON COUNTY.

Washington County, a typical Outer Bluegrass Area, is situated in central Kentucky. It contains about 299 square miles. The district is drained by Beech Fork of Salt River. Springfield, the county seat, has an elevation of 750 feet but hill lands surrounding rise somewhat above. The district—a



MARL BEDS IN WASHINGTON.

These outcrops occur on the C. M. Bringle farm. With others of similar character they have been used for agricultural purposes.

maturely dissected limestone plateau—is hilly throughout, the normal local relief varying from 100 to 150 feet. The maximum relief is about 225 feet.

The hard rocks of Washington County consist principally of limestones, shaly limestones, shales and thin sandstones of the Cincinnati or upper division of the Ordovician System. The Eden shale and Garrard sandstone are two of the most prominent and most easily recognized formational units. Although Ordovician sediments are preponderant in this region, in the southwestern part of the county restricted hill land outliers of Silurian rocks are found between Hardins Creek and Cartridges Creek immediately south of Frederickstown.

The structural attitude of Washington County is monoclinal, the normal dip being to the southwest from a medial position on

the southwestern flank of the Lexington Dome of the Cincinnati Arch. Local anticlinal and synclinal flexures are common, but faulting of major significance is not known.

The principal mineral resource of Washington County is limestone which occurs in adequate quantity and quality for highway, railroad bed, and rural building construction. Residual clays suitable for brick making are available in this district. It is probable that wells drilled to medium depths into the underlying Champlainian division of the Ordovician System would produce mineral waters of value, similar perhaps to those found in the type Blue Licks and Big Bone Lick regions of northern Kentucky.

Washington County with Marion was mapped in reconnaissance and published, in colors, at the scale of 1 inch equals 2 miles in 1882 by the Second Geological Survey. A summary geological report was later issued about 1887. The map is still available but the report is out of print. The topography of this district is unsurveyed.

CXVI.

WAYNE COUNTY.

Wayne County, exhibiting an area of 478 square miles, is located in southeastern Kentucky adjacent to the Tennessee line. The district is embraced partly within the eastern tip of the Pennyroyal and partly within the western border of the Kentucky portion of the Cumberland Plateau. Mature dissection characterizes the county throughout, the region being hilly in



OUTCROP OF BEAVER "SAND."

At practically all points of exposure this oil producing limestone of Wayne County shows cherty inclusions and is of ferruginous aspect. This view was taken on Beaver Creek.

the southeastern portion and undulatory to rolling in the central plateau area. This broad upland is marked by typical Karst topography, sink holes, sinking streams, caves and big springs. The Cumberland River, and its local tributaries the South Fork, the Little South Fork, Beaver, Otter, Big Sinking and adjoining creeks constitute the major lines of drainage. These streams are deeply entrenched along the eastern, northern and northwestern boundaries for considerable distances.

Monticello, the county seat, centrally located, has an elevation of 926 feet and is representative physically of the central limestone upland. Sulphur Spring Mountain, one of the highest if not the most elevated area in this district, is 1,550 feet above sea level. A minimum elevation for this region is 580 feet found at the juncture of Difficulty Creek and Cumberland River at the

Russell County line, giving a maximum relief of 970 feet. Local relief, however, usually ranges from 250 to 450 feet.

The hard rocks of Wayne County consist of a long sequence of Paleozoic sediments, limestones, sandstones conglomerates, shales and coals. These beds beginning with the uppermost Ordovician limestones exposed in the valley of the Cumberland River, along the northwestern boundary, extend upwards stratigraphically through the local sequences of the Silurian, Devonian, and Mississippian into the basal Pottsville (Pennsylvanian). Areally the Coal Measures encompass about two-fifths of the surface of Wayne County, these sediments being restricted essentially to three great outliers in the southeastern and southern divisions. The central limestone plateau is Mississippian throughout, these rocks being principally of Chester and Mamee age. Silurian, Devonian and Ordovician sediments are only found along the lower waters of the main Cumberland River.

Structurally the attitude of the rocks of Wayne County is monoclinal, the dip being to the southeast from a low-lying flank position on the Cincinnati Arch. Anticlinal and synclinal folds chiefly of the fingering type dipping usually to the southeast are recognized at many points throughout the county, but faulting accompanied by significant displacement is unknown.

The principal mineral resources of Wayne County are limestone and petroleum. The limestone occurs in large quantities widely distributed and sufficient for any reasonable demands of road building, railroad bed, rural and urban building construction. Certain grades of Wayne County limestones, particularly the correlative of the Gasper (oolitic) limestone in the Chester series is high in purity and might be used for agricultural lime and cement materials. Petroleum has been produced in Wayne County chiefly from the Beaver (New Providence-basal Mississippian) "sand" for about 30 or 35 years. The Beaver oil "sand," really a limestone, is generally found productive at depths ranging from 400 to about 700 feet. The oil producing area is confined to the central and southeastern part of the county, no considerable production extending northwest of the Albany-Monticello-Burnside Pike. The principal oil producing pools are: "Windy City," "Johnson," "Keeton," "Cooper," "Oil Valley," "Griffen," "Parmlesville," "Pisgah,"

"Johnson Fork," "J. A. Brown," "Turkey Rock," "Dry Hollow," "Slickford," and "Sunnybrook" south and southeast of Monticello; and the "Sinking," "Shiloh," "Spann," and "Stubenville" pools northeast and east of Monticello. A small amount of natural gas has been produced from the Beaver "sand," particularly near to and north of Monticello. The producing fields of this county are the most westward source of oil in the Somerset line of the Cumberland Pipe Line Company. During the two year period 1924 and 1925, Wayne County produced 264,045 barrels of petroleum, a recent yearly average of 132,022.5 barrels. Gas production reached its maximum in Wayne County in 1918. Since then it has declined. Sufficient natural gas occurs in many of the pools to facilitate drilling operations.

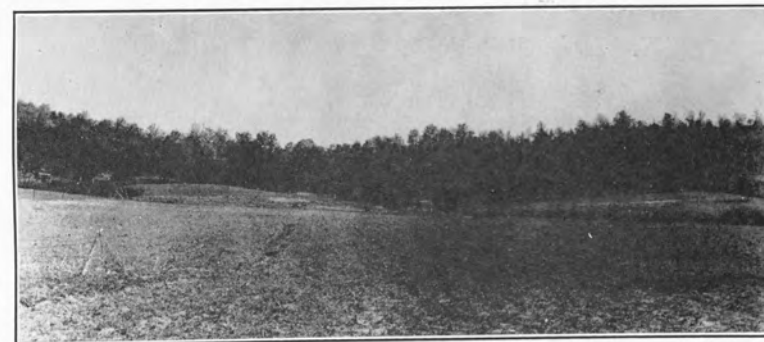
Clays suitable for the manufacture of ordinary brick and tile are available both as residual and transported deposits. Bituminous coal is mined for domestic purposes from two seams at a number of points in southeastern Wayne County, but due to lack of rail connections this district does not produce coal for export.

Wayne County was mapped in 1926 to show oil and gas development at a scale of 1 inch to the mile. The topography of the northern central part of Wayne County is shown on the Monticello Sheet, scale 1:62,500, contour interval 20 feet. The eastern part of the county is shown mapped on the new Burnside and Bartlett sheets at the field scale of 1:48,000.

CXVII.

WEBSTER COUNTY.

Webster County is located in the western-central portion of the Western Kentucky Coal Field. It contains about 344 square miles. Drainage is effected by the Green River and its regional tributaries—Graves and Deer creeks—on the northwest, the Tradewater River and its local tributaries—Crab Orchard and Slover creeks—on the southwest; and the headwaters of High-



TOPOGRAPHY EAST OF SEBREE.

Broad alluviated flats along Deer Creek in eastern Webster County are broken by the sandstone (Sebree) capped hills seen here in the background.

land Creek, a northwest flowing tributary of the Ohio River on the north. The district is one characterized by low rolling hills separated by broad flat alluviated stream bottoms. Dixon, the county seat, has an upland elevation of 544 feet, but hills along the Rough Creek disturbance to the north near Sebree rise to 645 feet. The broad valley bottoms range from 348 feet, the minimum elevation on the Tradewater River at the Union County line, to 390 and 400 feet above sea level. The maximum relief is therefore, 297 feet but the normal relief is usually not more than 150 or 200 feet.

The hard rocks of Webster County are all of Carboniferous age being referable to the Pottsville, Allegheny and Conemaugh formations. Along the Rough Creek disturbance and in the northern part of this county Upper Mississippian formations in-

cluding some of the Chester shales (Leitchfield) are brought to the surface by overthrust structural movements. The bottoms of the lines of major drainage are broadly filled with gravels, sands, silts, clays, and organic materials of Pleistocene and Recent age deposited under fluvial and lacustrine conditions.

The structural attitude of the rocks of Webster County is that of an anticline overthrust to the north and paralleled somewhat on the south by a geo-syncline. The dip of the consolidated sediments in the southwestern part of the county is northeast-



OLD WELL, NEAR TILDEN.

Shallow drillings north of the Rough Creek disturbance in Webster have produced small amounts of black oil from Pottsville sands.

ward into the axial basin at Clay. North of this trough the beds rise to the Rough Creek Fault. The Paleozoic sediments lying north of the Rough Creek disturbance dip gently to the north. The Rough Creek disturbance, a zone of fracturing and faulting of major significance—the most pronounced in western Kentucky—passes along a line of generally east-west strike through northern Webster County in the region between Steamport Ferry on the Green River, Sebree, and Tilden. In this locality prominently displayed folds of high angle are common, and overthrust faulting to the north is significantly exposed exhibiting a displacement ranging from upwards of 300 to 3,500 feet. This zone of fracture and flexure is relatively broad—the overthrust faulting being frequently replaced by normal *enechelon* faulting.



AT THE FACE OF NO. 11 COAL. In the Providence field this coal is excellently developed and extensively operated. This view shows a coal cutting machine at work in the Shamrock mine. The No. 11 seam is here six feet thick, overlain by limestone (Providence) and underlain by clay. It has a two inch shale parting.

The most important mineral resource of Webster County is bituminous coal which in 1926 attained an exported volume of 2,570,228 tons. Although about thirty separate seams of varying thickness, mostly very thin, are present in this district, No. 9 and No. 11 are the principal commercial coals now being mined. Oil of heavy base in small quantities has been encountered at shallow depths in the Pennsylvanian sands in several of the wells drilled in this district, particularly in the vicinity of Tilden and north of the Rough Creek Fault. The underlying Upper Mississippian sediments, particularly the exact correlatives of the important producing sands of the McLean-Daviess and Ohio fields to the northeast, may also be regarded as important potential oil producers in Webster County. Natural gas in considerable quantities has been secured in a number of isolated test wells from uncorrelated Carboniferous "sands." Clays suitable for ordinary brick and tile manufacture are available both as residual and transported deposits.

A soil map of Webster County in colors was issued at the scale of two miles to the inch in 1912. The district was mapped geologically to the scale of one inch equals one mile in 1923. A detailed report on this area was published by the Sixth Geological Survey in 1922. The area has been topographically mapped and is shown on the Morganfield, Sebree, Madisonville, Earlington, Calhoun, and Providence quadrangles, scale 1:62,500, contour interval 20 feet.

CXVIII.

WHITLEY COUNTY.

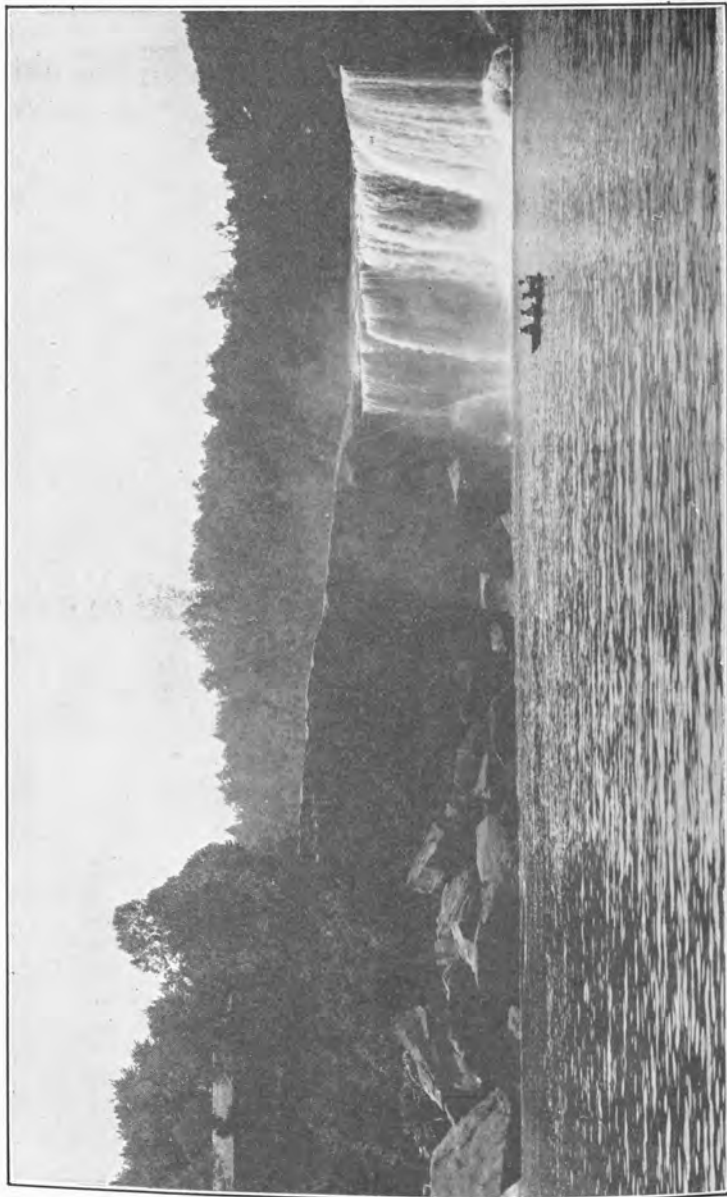
Whitley County is situated in southeastern Kentucky adjacent to the Tennessee line. Areally it covers 467.25 square miles. It is drained by the Cumberland River and its principal local tributaries, Laurel River, Jellico Creek and Clear Fork of Cumberland. The district is mountainous, being a very ma-



WOODLAND ROAD WEST OF CORBIN.

This part of Whitley County on the head of Spruce Creek is very sparsely settled. The Cumberland Plateau upheld by the heavy Pottsville conglomerate is but slightly dissected at points removed from Laurel River. Outcrops of the hard bedded Paleozoics, frequent as they may be elsewhere in the county, are uncommon here.

turely dissected area quite representative of the Kentucky portion of the Cumberland Plateau. Williamsburg, the county seat, with an elevation of 975 feet, is centrally located on a low spur which merges into the flood plain of a great meander of the Cumberland River slightly below the mouth of the Clear Fork. Winding ridges surrounding rise to 1,900 feet, while to the southeast, uplands on and adjacent to the Pine Mountain have elevations of 2,250 feet. The minimum elevation—750 feet—is found at the mouth of Laurel Creek at its juncture with the Cumberland, giving a maximum relief of 1,500 feet for the entire district. Local relief varies from 750 to 1,200 feet.



THE FALLS OF THE CUMBERLAND. The area surrounding the cataract is rugged, primitive, isolated and interesting. The old hotel seen at the left is in Whitley county while the timbered hills at the right are in McCreary. A strong ledge of Pottsville conglomerate sandstone supports the falls.

The hard rocks of Whitley County consist entirely of Paleozoic sediments, the lowest beds being upper layers of the Chattanooga (Devonian) black shale which occur as inliers, due to overthrust movements in the Pine Mountain Fault in the southeastern part of this district. Directly superimposed upon this formation occurs the entire local sequence of the Mississippian System, limestones, sandstones and shales, only portions of which are, however, exposed along the fault zone on Mud Creek.



ALONG THE WILLIAMSBURG-CORBIN ROAD.

The outcropping rocks—sandstones, shales and coals—are all of Pennsylvanian age and the topography is characteristic of this part of Whitley County.

The principal formation at outcrop covering areally over 97 per cent of the county is the Pottsville (Pennsylvanian). These rocks consist of sandstones, sandstone conglomerates, shales and coals, the total sequence of which attains a maximum thickness of approximately 1,500 feet. The valley bottoms of the Cumberland River and its major tributaries are chiefly alluviated with fluvial sands, clays, silts, etc., of Recent deposition.

The structural geology of Whitley County broadly described is geo-synclinal. The axis of this great trough enters the county from Tennessee in the vicinity of Redash and plunging northeastwardly passes about one and one-half miles north of Saxton, through Dal and following upstream along the Cumberland River crosses into Knox County at the head of Meadow Creek. Northwest of the low axial line the bedded rocks of Whitley County are monoclinal in the main, with normal dip

to the southeast into the geo-syncline; while southeast of the trough the consolidated surface sediments dip sharply north-westward from the plunging overthrust of Pine Mountain. Southeast of the Pine Mountain, a relatively small area on Laurel Fork dips rapidly to the southeast into the Middlesboro Syncline. The normal structure of Whitley County thus briefly described is flexed into minor folds, anticlines, doming anticlines and synclines of local significance, some of which are undoubtedly of much economic importance.

The principal mineral resources of Whitley County are bituminous coal and natural gas. In a sequence of about 12 or 13 coals, the Blue Gem and Jellico are the principal coals of operation. In 1926 this district mined and exported 671,069 tons of coal, chiefly to northwestern and lake port markets. Natural gas is secured at depths ranging from 1,100 to 1,381 feet, chiefly in the "Maxon," "Big Lime" and "Big Injun" (Mississippian) sands. Petroleum in commercial quantities has been secured from the Williamsburg "sand" (basal Pottsville-Pennsylvanian) in the vicinity of Williamsburg at depths ranging from 300 to 800 feet. A number of undeveloped oil and gas structures, such as the Perkins and Patterson domes, are available for testing purposes in this district. The Williamsburg gas field, located on an anticlinal structure of the same name, is the most important oil and gas producing field in this region. Its geology was described in Vol. 12, Series VI, Kentucky Geological Survey. Carbon black was produced from natural gas during the years 1923 and 1924 in the vicinity of Williamsburg.

Clays of both transported and residual character suitable for the manufacture of ordinary brick and tile are available. Limestones suitable for highway, railroad bed and rural building construction occur in the southeastern part of the county along the Pine Mountain overthrust fault on Mud Creek, but are somewhat removed from lines of rail transportation. Transported and residual sands and gravels are available for construction purposes. One of the most significant natural resources of Whitley County is the potential hydro-electric power indexed in projects involving the damming of the Cumberland River. One unit proposes a dam about one-half mile above Cumberland Falls, thereby ponding the river back upon its courses to Wil-



ST. LOUIS LIMESTONE ON PINE MOUNTAIN.

Although this great uplift and thrust fault passes for many miles through southeastern Whitley County the only significant limestone operation is this one on the Clear Fork and the Louisville and Nashville Railroad just across the State line in Tennessee. All of these beds lie in Whitley County, however, and in the vicinity of Williamsburg have produced large amounts of natural gas.

liamsburg. A second project proposes a dam in the lower course of the Cumberland River in the vicinity of Burnside or below in Pulaski County. This lower dam, if constructed, would pond the water of the Cumberland River back on its course into Whitley County to the base of the Cumberland Falls.

The rugged scenery of the Cumberland River, particularly in the vicinity of Cumberland Falls and the great gorge below, has in recent years received national recognition. This mountain region has been proposed as a State Park, to which purpose it would lend itself most admirably and present very considerable economic values.

An oil and gas map of Whitley County was published in 1927 at the scale of 1 inch equals 1 mile, the Fire Clay coal being contoured at 10 foot intervals throughout the district. Oil and gas development, as well as the location of coal mines, is shown on this map. Topographically Whitley County was mapped in reconnaissance on the Cumberland Gap and Williamsburg quadrangles, scale 1:125,000, contour interval 100 feet, in 1891 and 1894.

CXIX.

WOLFE COUNTY.

Wolfe County, covering an area of 205.26 square miles, is situated in central eastern Kentucky well within the Cumberland Plateau. A part of the Eastern Kentucky Coal Field, it is maturely dissected throughout, exhibiting a general relief ranging from 250 to 500 feet. Campton, the county seat, has an elevation of about 975 feet; but ridges to the southeast attain a maximum elevation of 1,450 feet. The minimum elevation of Wolfe County on the Kentucky River at the mouth of Lower Devil's Creek is about 650 feet, giving a maximum relief of 800 feet. The North Fork of the Kentucky and the Red rivers are the major lines of drainage.

The hard rocks of Wolfe County are all of Carboniferous age, these sediments being composed of limestones, sandstones, conglomerates, shales and coals. Beds of Chester limestone and the underlying Waverly (Mississippian) formation occur on the flowing waters of the Red River and its tributaries, Chimney Top, Parched Corn, Swift Camp, and Clifty creeks. These calcareous beds are also found on Graining Fork and Middle Fork near the Powell County line, but otherwise the district is entirely surfaced with rocks of Pottsville (Pennsylvanian) age. Thin alluviums consisting of sands, gravels, and clays principally of post-Pleistocene age are found along the various lines of larger drainage, including the North Fork of the Kentucky River, where somewhat more deeply laid, some portion of the fluvial sediments may be of Pleistocene deposition.

The structural attitude of the Paleozoic rocks of Wolfe County is that of a normally faulted monocline tilted pronouncedly to the southeast. The Irvine-Paint Creek Fault Zone exhibiting two lines of fissuring and displacement, one continuous, traverses the entire district. Paralleling this major fault on the south, a rather sharp fold, the Stillwater Anticline, strikes eastwardly across the county from about midway in the vicinity between Natural Bridge and Torrent to the Morgan County line, a little south of Hazel Green. Displacement along this line of fracture is various, ranging from 50 to 180 feet. Uplift is continu-



IRVINE-PAINT CREEK FAULT NEAR GLENCAIRN.
Down throw is on the right setting Ste. Genevieve-St. Louis limestone beds against the Cuyahoga-Waverly on the left of the break. Displacement is about 140 feet. Note the severe old man's face in the limestone cliff.

ously on the north side of the fault. The normal dip of the rocks elsewhere in the county is reversed by local flexures of anticlinal and synclinal type, the axial trends of which in some cases are significantly parallel to the major line of faulting which traverses the northern central part of the county. Such is the case in the instance of the Holly Creek Anticline in the southern part of the county near the Breathitt boundary.

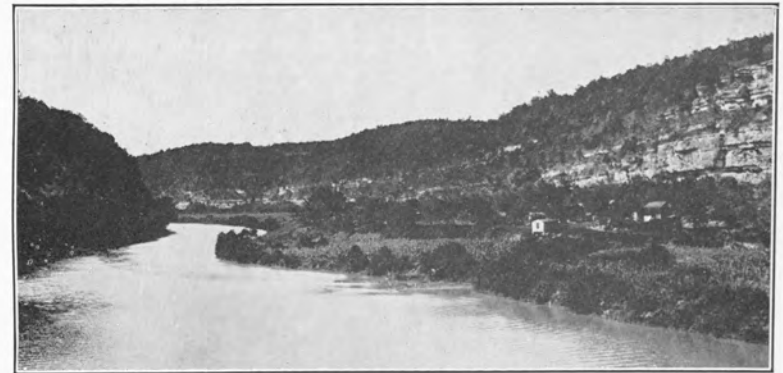
The principal mineral resource of Wolfe county is petroleum which has been secured in commercial quantities since 1903 from the Corniferous (Devonian) "sands." The most important producing areas are the Torrent, Campton, and Stillwater pools. While wells in this district have usually been of only medium size, medium depth—1,000 to 1,250 feet—and long life, have made possible an extended, unbroken record of production. A number of apparently favorable structures are still untested. The eastern part of this county exhibits numerous coal benches, many of which are operated for local purposes, but no coal is mined for export in this district. Sands and gravels of transported and residual character are available for general construction purposes. Limestones suitable for highway, railroad bed and rural building construction are present on the headwaters of the Red River. In this same vicinity near the Menifee County line flint fire clays are reported to be existent stratigraphically at the point of contact between the Mississippian limestones and the overlying Pennsylvanian formations.

A structural and areal geological map of Wolfe County with stratigraphic and structural sections was published in 1927 at the scale of 1 inch equals 1 mile. The topography for this area is shown on the Beattyville and Salyersville quadrangles, scale 1:125,000 with 50 foot contour interval.

CXX.

WOODFORD COUNTY.

Woodford County is located in central northern Kentucky in the heart of the Inner Bluegrass. The area is an undulatory limestone upland embracing about 195 square miles drained by the Kentucky River and its principal local tributaries, Elkhorn,



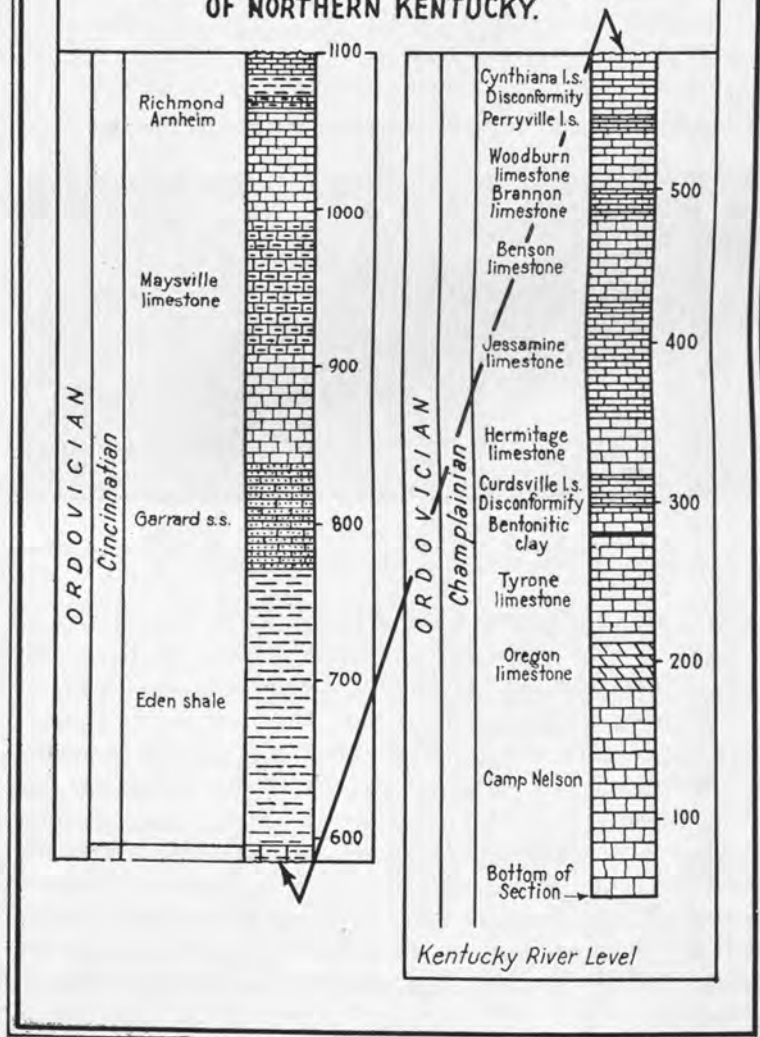
THE CLIFTED KENTUCKY.

Throughout its course in Woodford County this beautiful stream flows in a gorge cut in white Ordovician limestones. This view is just below Brooklyn Bridge.

Glens Creek and Clear Fork. Versailles, the county seat, with a somewhat central location has an elevation of 923 feet which is representative of the higher upland area. The maximum elevation of the county is about 1,005 feet. The minimum elevation, 480 feet, is found at the mouth of Glens Creek near the Franklin County line, thus giving a maximum relief of 525 feet for the entire district. Precipitous topography is characteristic along the gorge of the Kentucky River on the southern and western boundaries of this county where trenching in sharp meanders to an average local depth of 330 feet is characteristic. The removed upland areas, however, exhibit only a rolling topography usually with less than 75 feet of relief but occasionally attaining as much as 150 feet.

The hard rocks of Woodford County consist of an important sequence of Ordovician limestones, shaly limestones and shales,

GENERALIZED STRATIGRAPHIC SECTION FOR FAYETTE, WOODFORD, JESSAMINE, GARRARD, SCOTT, OWEN, AND ADJACENT COUNTIES OF NORTHERN KENTUCKY.



STRATIGRAPHIC SECTION FOR WOODFORD AND OTHER ADJACENT COUNTIES OF NORTHERN CENTRAL KENTUCKY.

beginning with massive Camp Nelson formation (Champlainian) and extending upward through the Cynthiana limestone into the Eden shale of the Cincinnatian. The flood plains of the low major lines of drainage—particularly the Kentucky River—are constricted, but exhibit sands, silts, clays and organic materials of Pleistocene and Recent age.

The structural attitude of the Paleozoic rocks in Woodford County is monoclinal, the dip being at very low angles westward from a crestal position close to the top of the Lexington Dome of the Cincinnati Arch. Faulting with considerable displacement

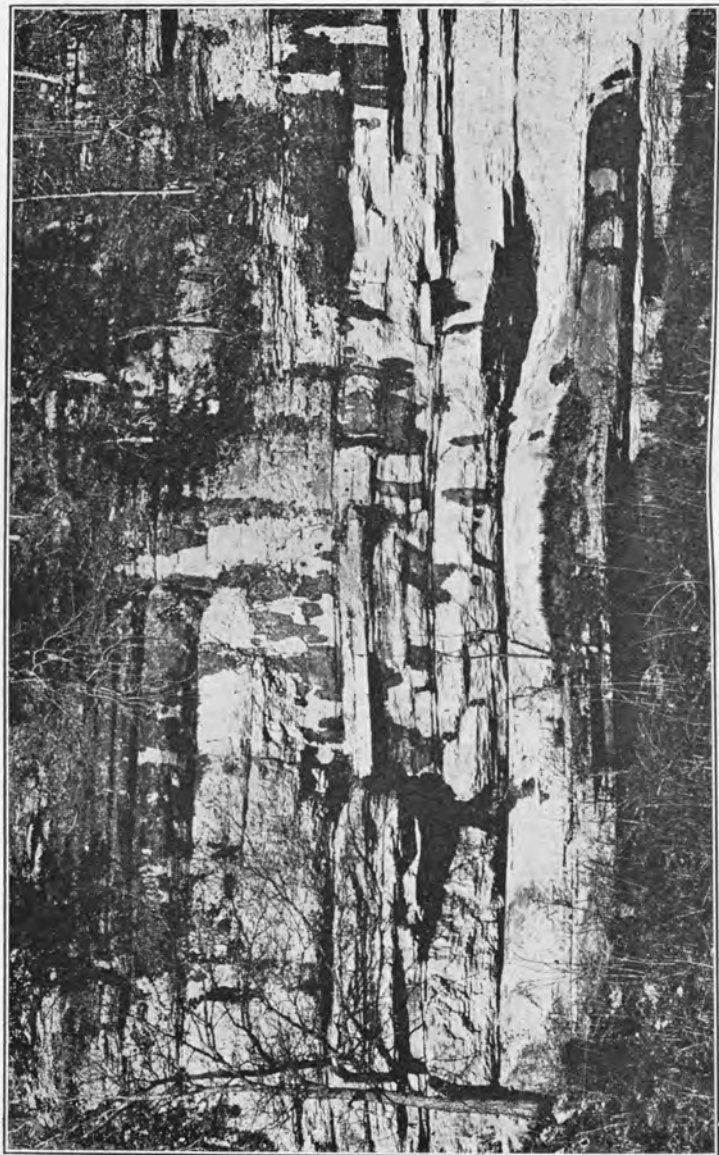


FAIRCLOTH FLUORITE VEIN IN WOODFORD.

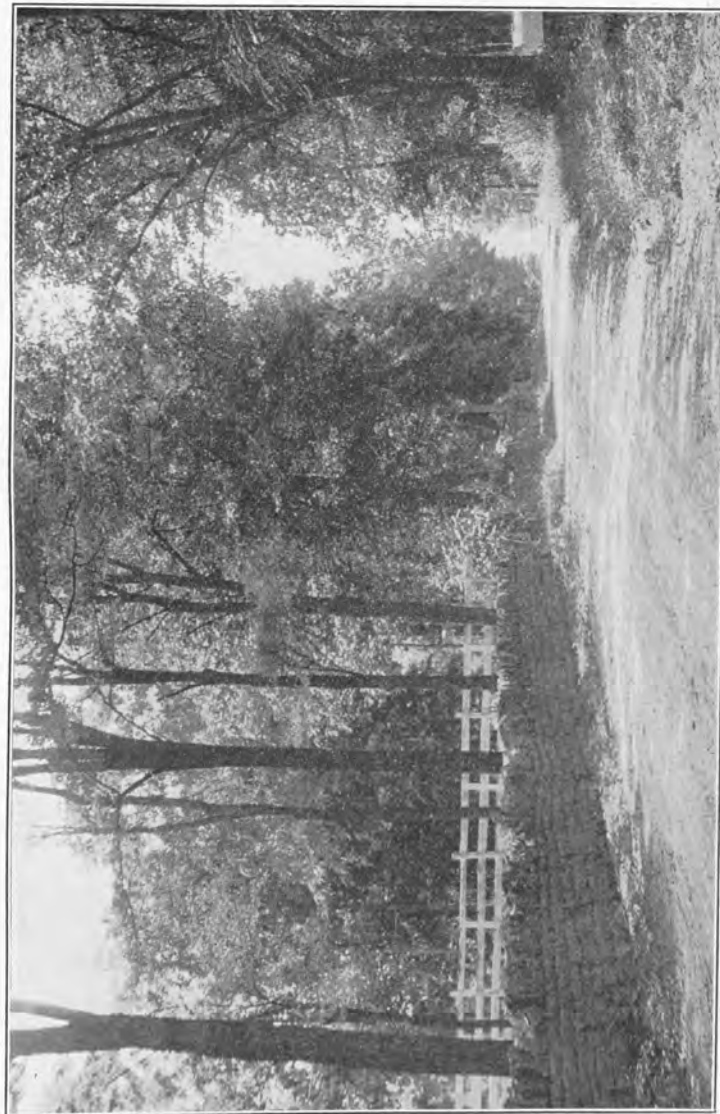
Only drift mining has been followed in operating this important fluor-spar deposit on the Kentucky River at Mundy's Landing.

is unknown in Woodford County, though small mineralized fissures exhibiting a small throw are present in the southern part of the county near Mundys Landing on the Kentucky River.

The principal mineral resource of Woodford County is limestone, which occurs in inexhaustible quantity and in quality suitable for highway, railroad bed, rural and urban building construction. The Tyrone limestone, one of the best and most widely known building stones of central Kentucky, is available along the gorge of the Kentucky River. Certain Woodford County limestone beds are sufficiently high in calcium carbonate (CaCO_3) to be of value as agricultural limes, and others are sufficiently free of magnesium to be important from a standpoint of cement materials. Sands suitable for building construction occur in the channel of the Kentucky River. Mineralized fissure veins containing fluorite, barite, calcite, galenite, sphalerite and



CLIFFS OF TYRONE LIMESTONE AT MUNDY'S LANDING.
The lowest Ordovician beds in Kentucky throughout their entire extent in the gorge of the Kentucky River present a nearly perpendicular face. This exposure is in southern Woodford County.



ALONG THE MIDWAY-VERSAILLES PIKE.
This enchanting meadow land—Woodford—carpeted with bluegrass and spotted with ancient groves of oak, unfolds itself in broad undulations as pleasing to the eye as they are easily traversed. Relic of Tertiary peneplaination, it is the garden spot of Kentucky.

other associated minerals occur in the southern part of this region.

The Woodburn bed in Woodford County, particularly in the northern part of the district, in the vicinity of Midway and Wallace Station, is highly phosphatic, and has been operated extensively during the last decade for rock phosphates which have been exported from Kentucky. Throughout this county there are other areas unusually rich in phosphates, though perhaps not sufficiently so for mining or commercial purposes. The presence of this phosphatic formation, however, has resulted in producing residual limestone soils rich in phosphate and very highly productive, giving this region its familiar name, the "Asparagus Patch" of the Bluegrass Region.

A geological map of Woodford County was published in 1924 showing stratigraphic sections. The topography of this district is available on the Harrodsburg Quadrangle at the scale of 1:125,000, contour interval 50 feet; and on the Georgetown and Frankfort quadrangles at the scale of 1:62,500, contour interval 20 feet.

ERRATA

(GEOLOGY AND MINERAL RESOURCES OF KENTUCKY)

- Page
- 13—Line 5—Substitute Capital "O" in outer.
- 16—Title—Substitute singular "Mountain" for "Mountains."
- 19—Line 14—Substitute Capital "U" in "upper."
- 36—Line 2—Insert comma before "interrupted" and comma after "folding."
- 53—Line 15—Substitute Capital "U" in "upper."
- 53—Line 7—from bottom—Substitute Capital "U" in "upper."
- 55—Next to last line at bottom of page after the word "clays" insert "rock asphalt."
- 55—Line 13—Insert "upon" for "above" limestone.
- 55—Line 13—Substitute Capital "U" in upper.
- 78—Line 10 from bottom—Insert "of" after "be."
- 78—Line 9 from bottom—Remove comma after "age" and insert period. Remove "but" and substitute "They." Remove "later" and insert "Cretaceous."
- 90—Line 4 from bottom—Insert after period, "cave onyx occurs in the caverns of this and adjoining counties."
- 95—Line 3—Remove "and."
- 97—Line 1 below picture—Insert "River" to read "Kentucky River."
- 118—Substitute Capital "B" in brannon.
- 125—Insert at end of second paragraph: "Veins containing barite and calcite occur."
- 150—Title—Substitute "Monterey" for "Monerey."
- 166—Insert to conclude last paragraph: "Mineral springs and wells occur at Dawson Springs. Limestone and sandstone occur especially near Madisonville and Nortonville. It is used for constructional purposes, railroad ballast, road metal, and the like, while the purest limestone is crushed and sold for agricultural lime."
- 172—Line 6—After "shales," insert "up through the Silurian and Devonian limestone."
- 172—Line 8—Substitute "into" for "up through."
- 175—Line 3 below picture—Substitute "have" for "has."
- 180—Line 7 from bottom—Substitute "Middle" for "Lower."
- 199—Line 1—Substitute "Upper" for "Middle," and "Middle" for "Upper."
- 217—Line 3 below picture—After the word "petroleum" insert: "Mineral waters of medicinal value occur at Crab Orchard."
- 217—Line 6 from top—After "district" insert: "The Cuyahoga formation of the New Providence (Mississippian) is here and elsewhere throughout the Knobs of value for the manufacture of brick, tile, and similar clay products."
- 220—Title—Substitute "1:62,500" for "1:62,600."
- 221—Line 17—Insert after the word "River:" "At Gravel Switch on the Illinois Railroad are large commercial beds."
- 228—Title—Substitute for "Fault in Cumberland River—" "Fault in limestone along Cumberland River."
- 229—Title—Substitute "Cretaceous" for "Crefaceous."
- 245—Line 9 from bottom—Substitute "Porter's" for "Parter's."
- 272—Line 5—After the word "lime" insert "Barite and Fluorite occur in veins sometimes in economic quantities. A commercial vein of calcite is found near Mundy's Landing."
- 338—Line 6—Insert "of" between "clays" and "transported."
- 338—Line 2, last paragraph—Substitute after "1927" "by" for "of."
- 351—Line 6, second paragraph—Substitute "Monadnock" for "mondanock."
- 374—Line 5 below picture—Substitute "toward" for "at."

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(NOTE: Geological and formational names are omitted in this index because of the numerous repetitions.)

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